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Osteoarthritis of the Hip

With Special Reference to Treatment by Vitallium Mould Arthroplasty

BY W. ALEXANDER LAW, O.B.E., M.D., F.R.C.S.

This monograph is published by kind permission of the British Orthopaedic Association, whose Robert Jones Prize and Gold Medal it won in 1950. The author reviews a series of cases which were treated by Vitallium mould arthroplasty, following Smith-Petersen's technique closely. Definite points are made with regard to the aetiology of this condition, and other forms of treatment are also discussed. The text is illustrated by excellent photographs made at The London Hospital by MR. R. H. RUDDICK.

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SURGICAL PROGRESS

1952

Under the General Editorship of

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PUBLISHERS' ANNOUNCEMENT

Surgical Progress for 1952 is the second of an annual series of supplementary volumes to *British Surgical Practice*. It is designed to keep the eight main volumes up to date in an ever-increasing field of surgical knowledge. This is being done in three ways—by original articles, critical surveys and abstracts.

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September, 1952.

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INTRODUCTION

In this volume of Surgical Progress for 1952 we have endeavoured to follow the plan of amplifying or making good omissions in British Surgical Practice in the light of recent experience It is appropriate that this process of revision should be undertaken when possible by the original authors, and on this occasion we are indebted to Professor Ian Aird, Mr. A. B. Wallace and Mr. J. B. Kinmonth for adding to their contributions to the original work; but we are equally grateful to the other contributors to this volume whose assistance has been sought because of special knowledge and experience of their subject

Certain of the subjects have been chosen because we considered that the time has come for a review of current methods of treatment—arthritis, burns, restorative resection of the rectum, pre-frontal leucotomy, and the treatment of hypertension fall into this category. Others may be regarded more as a statement of present-day technique, and the chapters on heart surgery, anaesthesia and chronic oedema of the leg may be grouped under this heading The chapter on the intestines provides a comprehensive review of current teaching and practice, that on malignant exophthalmos clarifies much that has been obscure in this confusing condition; and the account by Professor Bentley and Dr. Barlow of the researches of their team on the physiology of the vascular system of the stomach and the abnormalities found in relation to peptic ulceration provides a record of researches which are of much importance to the practising surgeon.

E. ROCK CARLING.
J. PATERSON ROSS.

ARTHRITIS—SURGICAL TREATMENT OF CHRONIC ARTHRITIS

By W. ALEXANDER LAW, O.B.E., M.D., F R.C.S.
Assistant Surgeon, Orthopaedic Department, the London Hospital; Associate Surgeon, Robert Jones and Agnes Hunt Hospital, Oswestry; Orthopaedic Surgeon, Tilbury and Riverside Hospital

In recent years great progress has been made in both the conservative and the surgical treatment of chronic arthritis. *This term is meant to include groups of (1) osteoarthritis* or degenerative arthritis and (2) rheumatoid arthritis and ankylosing spondylitis. The need for surgical reconstruction in the treatment of the pain, the fixed deformity or the disability, which results from any of these kinds of arthritis, is now more widely recognized; but at the same time it must be stressed that surgery is indicated only when the patient is no longer responding to the correct type of conservative treatment, or for the relatively few patients in whom, at the time they present for treatment, the disease has advanced too far to make conservative measures worth while. The correct time to operate, therefore, is not always an easy decision, but it is one which must be made by a team comprising the physician, orthopaedic surgeon, physical medicine expert and, in some cases, radiotherapist, working together

Skilled nursing and physiotherapy form an essential background for both conservative and operative treatment in all these cases, and it is important that the clinician should supervise this treatment programme in detail.

Osteoarthritis

DEFINITION

This type of arthritis, which is also called hypertrophic arthritis or arthrosis deformans, occurs in many parts of the world and is markedly different from the rheumatoid or atrophic type of arthritis, although it may be superimposed upon the latter. Sometimes a true polyarthritis is seen, with involvement of multiple joints, including those of the small peripheral joints of the hands and feet, but as a rule a single large joint, such as the hip or knee, or several large joints, such as both knees and hips, are involved.

AETIOLOGY

Primary and secondary forms

Wear and tear in primary osteoarthritis

Osteoarthritis is best regarded as a wear-and-tear process, which may occur naturally without any obvious precipitating factor, this being the so-called primary or spontaneous osteoarthritis On the other hand, there may be some basic derangement of the joint resulting from injury or disease, or some congenital aberration, which results in incongruity of the joint surfaces, and this will predispose to earlier or more rapid wear-and-tear changes. This latter type of osteoarthritis may be termed secondary, and it is more likely to be found in young adults or the middle-aged group of patients. In the old-age group, the primary type of osteoarthritis is seen, and an

example of such is the malum coxae senilis or coxa magna. In both primary and secondary osteoarthritis the reaction on the part of the synovial membrane, capsule, articular cartilage and bone is similar, but in the secondary type there is always some fundamental upheaval in the joint mechanics, which initiates and hastens these changes.

Other principal factors

The following factors play a part in the production of osteoarthritis.

Joint dysplasia.—Dysplasia, such as congenital dislocation or subluxation of the hip, in which a shallow acetabulum and a misshapen femoral head, together with anteversion of the femoral neck, give rise to unstable and unsound joint mechanics. Thus patients as young as 25–35 years of age are seen with well-marked osteoarthritic changes and symptoms.

In a series of over 200 cases of osteoarthritis of the hip, which came to surgical treatment, congenital dysplasia was responsible for nearly 40 per cent of the secondary group (Law, 1952). This incidence corresponds with the findings of other surgeons, such as Gade (1947). A little over 50 per cent of the patients in this series were diagnosed as suffering from primary osteoarthritis, but there does appear to be a slight degree of slipping of the upper femoral epiphysis in quite a large number of these cases, although no symptoms or signs were noted during adolescence. The findings at operation, although less marked than those of the more obvious and severe cases of old slipped upper femoral epiphysis (Fig. 1), often closely resemble them in that most of the hypertrophic reaction is found infra-posteriorly at the cervico-capital junction. It is possible, therefore, that a slight degree of epiphyseal displacement is a more frequent factor in producing incongruity and subsequent secondary degenerative changes than has been previously considered.

Trauma.—Either fractures within or into the joint, or traumatic dislocation may result in distortion of the joint surfaces, or may result in secondary changes because of interference with the blood supply to the articular cartilage and bone in the neighbourhood of the joint. Thus avascular necrosis occurring after femoral-neck fractures is rapidly and frequently followed by osteoarthritic changes in the hip joint. A more rare but somewhat more dramatic type of vascular interference in the head of the femur is sometimes seen in caisson disease, the result of nitrogenous embolism or intra-osseous vascular compression, with consequent marked distortion of the femoral head and secondary osteoarthritis.

Associated bone disease.—Some generalized bone or joint diseases are commonly associated with osteoarthritic changes in the neighbouring joints. Thus in acromegaly or Paget's disease, commonly seen in the pelvis, femur and tibia, the corresponding hip and knee joints may show extensive osteoarthritic changes. These may also be aggravated by distortion of the areas of weight bearing in the long bones themselves, for quite severe genu valgum or genu varum is of common occurrence in these conditions. Perthes' disease and slipping of the upper femoral epiphysis are commonly followed by degenerative changes in the hip joint at a very much earlier age than is seen in the true primary form of the disease.

Aging.—Primary osteoarthritis of a joint, such as the hip, may be regarded as an old-age change. Possibly the joint elements are reacting to deficiency of circulation from changes in the vessels to the joint; alternatively, the small end-arteries in the subchondral bone of large joints subject to the severe stress and strain of weight-bearing and incessant movement may be partly or completely obliterated, with consequent necrosis of the articular cartilage.

In a primary group of 144 consecutive cases, the average age of the patient at the time of operation was 61 years, whereas in a secondary group of 73 cases, the average age was definitely lower, being 48 years.

Vascular defects.—Vascular interference is suggested somewhat by radiological appearances, where wedge-shaped sectors of relatively dense avascular bone may be seen, particularly in the upper part of the femoral head and superior acetabulum. These would correspond very well with local vascular interference from embolism or thrombosis and consequent degeneration of the joint. It has also been suggested that arteriosclerosis in the vessels of the bone underlying the articular cartilage is the principal factor in the production of osteoarthritis; but microscopically there is no evidence of this and avascular changes are not always encountered.

Subsidiary factors

Other factors which may play a part in the production of osteoarthritis, though to what extent is not yet determined, include the following: (1) endocrine disturbances,



Fig. 1.—Mild bilateral osteoarthritis of the hips, probably due to a slight degree of old slipping of the upper femoral epiphyses.

which probably accelerate the aging process; (2) nutritional deficiency of the joint structures, possibly resulting in disturbance of the enzyme system in the articular cartilage; vitamin D may be concerned in this respect; (3) allergic reactions to foci of chronic infection, such as the teeth and tonsils, although therapeutically this theory has not proved very fruitful, and there is no evidence of any infective process, microscopically or bacteriologically.

PATHOLOGY AND CLINICAL PICTURE

From the pathological point of view, no new findings have been reported, although in this series of cases a careful investigation, histologically and by culture of material removed from these joints, has definitely proved that there is no bacterial contamination.

Causes of pain

The recent work of Kellgren and Samuel (1950), who have reported that the fibrous ligaments contain many more "pain spots" than does the synovial membrane, may explain how the relief of pain in these osteoarthritic joints is frequently achieved by excision of the joint capsule and its associated ligaments, though it is also claimed that drilling of the bone, particularly when cystic changes have occurred, also relieves pain effectively.

Whatever joint is involved, pain is usually the presenting symptom, although stiffness and deformity are frequently present in addition. As a rule the latter is not realized by the patient and can only be determined by the clinician. In some cases pain is present long before there are clinical or radiological signs of change in the articular cartilage or bone. This would suggest that changes in the synovial membrane and capsule must cause reactions in the many sensory nerve-endings in these structures. Resection of the synovial membrane and capsule, even though subtotal, does produce alleviation of pain, at least temporarily, and if pain recurs in these cases it must be due to regeneration of the pain nerve-endings in the new joint capsule. Distension of the joint capsule by excessive fluid may also be a factor in the production of pain, but the actual incongruity of the articular surfaces seems to be of little or no importance, although in the later stages, in areas where the articular cartilage has been completely eroded, the nerve fibrils in the underlying bone may be exposed to direct trauma and irritation. It is well known that pain may be referred along the corresponding neurological segments, so that a case of arthritis of the hip frequently presents with pain in the knee or back.

CONSERVATIVE TREATMENT

General measures

Before considering surgical or operative measures, there are certain points wit regard to conservative treatment which are worthy of note. The patient must lear to adapt his life to the osteoarthritic joint concerned. This may even necessitate change of occupation, a sedentary type of work being required.

Weight reduction is frequently indicated when joints of the lower extremities ar involved and, if a choice of climate can be made, a dry warm one appears to be th most suitable for the osteoarthritic patient.

In the past a great deal of trouble has been taken to search for and eradicate foc of infection, which may be of importance if allergy is regarded as a real aetiologica factor. However, this does not mean that dental extraction or tonsillectomy must b carried out rashly, or to an unlimited extent as was formerly practised.

Physical medicine

Physical-medicine methods, in conjunction with orthopaedic splintage, form the basis of conservative treatment, and are particularly beneficial in the earlier stages of the disease. The objects of such treatment are as follows.

(1) *To diminish pain*

(*a*) *Thermotherapy*.—In this respect heat is most beneficial, because it increases the circulation through the degenerated tissues. The circulation may also be improved by gentle massage. The type of heat used may be superficial or deep according to the joint involvement.

(*b*) *Immobilization*.—Immobilization in plaster-of-Paris splints or the more modern plastic casts is also valuable in overcoming pain. In osteoarthritis of the spine,

the Goldthwait or Spencer type of lumbo-sacral corset and the plastic cervical collar are most useful, being relatively comfortable, easy to apply, and efficient.

(2) *Prevention of deformity*

The avoidance of fixed deformity is very important, and for this purpose the use of splints or traction methods may be indicated Plaster-of-Paris night shells and various forms of skin or even skeletal traction help in counteracting muscle spasm and also in relieving pain.

(3) *Preservation of muscles*

Muscle wasting and loss of tone and power are counteracted by active exercises together with assisted exercises in the early stages, and by resisted exercises later. In certain cases the exercises are supplemented by electrical stimulation, such as faradism. Muscle co-ordination and power are also encouraged by the use of special apparatus, such as the stationary bicycle, the rowing machine and the Guthrie-Smith slings.

(4) *Radiotherapy*

On the whole, x-ray therapy has also proved most disappointing with regard to the relief of pain and the arrest of the joint degeneration in osteoarthritis.

Chemotherapy and vaccines

Chemotherapy, in the nature of gold and bismuth salts, has not proved particularly efficacious, nor has vaccine therapy, even though an autogenous vaccine made from a septic focus, such as a tonsil bed or carious dental root, has been used.

Injection of acid

In recent years Grant Waugh (1951) has introduced a treatment of acid injection into the joint, with the object of altering the *p*H of the articular fluid Lactic acid and acid sodium phosphate have been used for this purpose, and even combined with procaine; but in many cases only a temporary relief, at the most, has been obtained. The result of this type of intra-articular injection is perhaps better in the knee than in the hip, where undoubtedly it is extremely difficult to insert the needle into the joint space, not only on account of the depth of the joint, but because the capsule and the synovial membrane become markedly adherent to the neck and head of the femur in the more advanced and dry stage of the disease.

Aspiration

Aspiration of the joint effusion may be beneficial in that it counteracts the stretching of the joint capsule and the associated ligaments by the excessive amount of fluid formed in the joint.

Manipulation and tenotomy

Manipulation of an osteoarthritic joint may also be of value in the earlier stages in order to maintain movement and even counteract deformity. This manipulation must be gentle and not brutal, for excessive trauma will only result in a more severe development of adhesions. Manipulation may be carried out under local or general anaesthesia, and may be repeated on several occasions, the manipulation being carried out through only a small range at a time, followed by active exercises and heat therapy. Tenotomy of tight or spastic muscles, such as the adductors of the hip, is also helpful and can easily be combined with manipulation under anaesthesia.

In a great number of cases of osteoarthritis, in spite of sound, early and efficient conservative treatment, the joint deterioration continues steadily and relentlessly, usually over a period of several years, with gradually increasing impetus, until

finally the pain, stiffness or deformity no longer yields to this type of treatment and the patient is faced with the alternatives of surgery or of invalidism with a crutch, wheel-chair or bed existence. In cases in which surgery is contra-indicated on constitutional grounds or on account of coincidental disease, certain orthopaedic appliances are indicated. A walking caliper may be of value in osteoarthritis of either the hip or knee joint, or the block-leather spica may be useful for the hip. With modern anaesthesia and modern resuscitative measures, more patients should avoid absolute invalidism, and under present-day economic conditions this is a most important aspect of the problem.

SURGICAL INTERVENTION

Indications

With regard to the problem of age at operation, it must be noted that the patient's physiological age is of much more importance than the actual number of years, and that surgery for the aged is nowadays very much safer and more common.

Operative treatment is indicated when conservative measures are failing to give relief, and this should not be delayed until symptoms are severe, muscle wasting extreme, and the patient completely crippled.

Forms of surgical treatment

There are various forms of operative treatment, which fall under two main headings: *(1) palliative, and (2) reconstructive. In the former, relief of pain is usually the* main objective, and such operations include: (i) synovectomy, (ii) joint neurectomy, (iii) cheilotomy and acetabuloplasty, and (iv) chordotomy.

PALLIATIVE OPERATIONS

Synovectomy and capsulectomy

These measures are most frequently employed in the hip joint, but sometimes are carried out in the knee. The operation is really a subtotal removal of the synovial membrane or capsule from the anterior, superior and inferior aspects of the joint, and in the hip this is usually combined with excision of the overgrown anterior acetabular rim (acetabuloplasty), and removal of any accessible osteoarthritic outgrowths (cheilotomy) from the femoral head and neck, together, of course, with removal of any accessible loose bodies from within the joint. In the knee, this can be combined with excision of the patella, particularly if there are marked osteoarthritic changes on the articular surface of the patella, or on the corresponding articular surface of the lower end of the femur. The reasoning behind this type of operation is ablation of the sensory nerve-endings in the joint capsule and its associated ligaments. Undoubtedly a fibrous-tissue capsule regenerates quite rapidly, probably within 6 or 8 weeks, but the nerve-endings take very much longer to do this, and the removal of bony outgrowths around the articular margins may eliminate some of the mechanical block to joint movement.

Joint neurectomy

Tavernier (1948) and Obletz and his colleagues (1949) have advocated joint neurectomy. In the hip joint they excise the obturator nerves, preferably intrapelvically, together with the branch to the hip joint from the nerve to the quadratus femoris. Of course, this is really an incomplete denervation, for many small branches from the femoral nerve to the joint are left intact. The obturator nerve

is approached extra-peritoneally and supra-pubically, and is resected at the obturator foramen, whereas the branch from the quadratus femoris is reached through Henry's approach and carefully checked by electrical stimulation before division, care also being taken not to injure the sciatic nerve. (*See also* Liebolt, Beal and Speer, 1950; Mulder, 1948.)

On the whole, the results of joint neurectomy have proved disappointing, pain returning to the joint within 1–12 months in many cases, whereas in the cases treated by capsulectomy many have remained pain-free, or with minimal pain only, for a matter of 3–4 years. In some cases treated by obturator neurectomy, troublesome symptoms have arisen later as a result of painful neuroma formation at the divided nerve endings.

Chordotomy

This is a more drastic method of attempting to break the pain pathways but, apart from the technical difficulties of the operation, the procedure has not by any means always proved effective. As a rule, if pain is so severe as to demand such treatment, a major reconstruction of the joint concerned is usually warranted and is more certain in its results; it does not expose the patient to any greater risks. The operation consists in dividing the spinothalamic tract on the opposite side in the thoracic region.

RECONSTRUCTIVE OPERATIONS

Major reconstructive measures in osteoarthritis may be classified under the usual four headings of (1) arthrodesis, (2) osteotomy, (3) arthroplasty and (4) pseudo-arthrosis. There is no danger in performing an intra-articular type of operation, as is sometimes the case in old infective arthritis, in which the likelihood of reactivating the infective process may be present.

Arthrodesis

Indications

Arthrodesis is the classical line of treatment for single-joint involvement, particularly in the lower limbs where stability and freedom from pain in weight-bearing are essential. Whatever form of joint reconstruction is carried out, alleviation of pain and stability must be the first considerations, movement or stiffness being secondary to these two important criteria. In osteoarthritis of the hip, where there is a single joint involvement and there is no arthritis in the lumbo-sacral spine or knee joints, arthrodesis gives a painless and stable limb, which can stand up to any amount of hard work, including prolonged weight-bearing and walking over rough ground. In young patients the compensatory movement in the lumbo-sacral spine may even mask the stiff hip, and enable the patient to carry out such activities as climbing ladders. In the more elderly patients, however, a stiff hip may put additional strain on the lower portion of the back and, in addition, the prolonged period of plaster immobilization may result in a stiff knee, which is an additional handicap to a patient who already has an arthrodesed hip.

Methods of arthrodesis

Various methods are employed for arthrodesing the hip in osteoarthritis.

(1) Intra-articular, with erasion of the cartilage on the acetabulum and the femoral head, supplementing this type of fusion with cancellous bone chips.

(2) The intra-articular procedure combined with the long three-flanged nail, as described by Watson-Jones (1938).

(3) The Brittain type of arthrodesis, which is an extra-articular procedure, with an ischio-femoral graft.

(4) A graft from the ilium to the trochanteric region, the so-called Wilson type of operation (Wilson, 1927).

Whether the intra-articular, extra-articular or combined type of arthrodesis is carried out, it is usually essential to supplement the internal fixation by external fixation in the form of a plaster-of-Paris spica, which may have to be applied for as long as 3–6 months. This prolonged period of immobilization is not ideal for the more elderly type of patient, as is usually the case in the malum coxae senilis group; but for the younger patient, in a case falling into the secondary osteoarthritic group, the prolonged period of immobilization is less dangerous at the time and less likely to produce prolonged stiffness of the adjacent knee joint. When arthrodesis fails to consolidate correctly and a fibrous union results with pain or instability, revision of the operation, in the nature of re-arthrodesis, or of osteotomy, arthroplasty or pseudo-arthrosis, can always be carried out without a great deal of difficulty.

Arthrodesis of the knee joint.—In the knee joint, arthrodesis is the most effective way of providing a painless and stable limb, capable of weight-bearing. Again, several methods have been employed for effecting this arthrodesis, from simple erasion (scraping) of the articular cartilage with coaptation of the raw bone surfaces and external fixation in plaster, to the use of grafts or obliquely placed three-flanged nails to give internal fixation. One of the more recent methods is that described by Charnley (1951), who has claimed extremely rapid fusion by the use of transfixion pins and turnbuckle screws, so as to compress the raw bone surfaces together.

Spinal arthrodesis.—In the spine, arthrodesis is commonly employed for fixation in the lumbo-sacral and cervical regions. This may be combined with the removal of osteoarthritic outgrowths in the intervertebral foramina. Such bony outgrowths have been shown to cause nerve-root irritation, with pain referred down either the upper or the lower extremity, or even to cause pressure on the cord itself, producing a lesion of the upper motor neurone type. In such cases, the wide bone removal in the course of a laminectomy and foraminotomy necessitates a spinal fusion in order to give subsequent stability and freedom from pain in either the cervical or lumbar spines. Similarly, spinal fusion may be indicated in cases of prolapsed intervertebral disc, with associated osteoarthritic changes, which are liable to cause pain after the disc has been removed. Such a fusion may be carried out either at the same time as the disc operation, or as a secondary procedure, if pain has persisted or recurred following a disc removal.

The most common method of performing spinal fusion is the modified Hibbs type of operation, combined with the use of cancellous bone chips; frequently nowadays, the Bosworth H-graft is also inserted, particularly in the lumbo-sacral region. American surgeons commonly employ internal fixation in carrying out spinal fusion, either inserting screws across the intra-articular facets or using plates inserted on to the spinous processes. [illegible]

(1949) has reported an incidence of 3 per cent of subsequent [illegible] of lumbo-sacral spinal fusion when one interspace alone was bridged; when the fusion extended from the fourth interspace to the sacrum, the percentage of pseudo-arthrosis rose to 17. Failed fusion, therefore, is a complication which must be very seriously considered in all cases of lumbo-sacral arthritis treated by this operation.

Arthrodesis of the wrist and hand.—In the upper extremity, arthrodesis is most frequently required in osteoarthritis of the wrist, particularly when it is secondary to the old ununited fracture of the scaphoid. In such cases a sound fusion, with a graft extending from the radius to the base of the third metacarpal and the hand in the grasp position, gives very satisfactory function for the digits and freedom from pain. An alternative method in such instances is an intercarpal fusion which may be of value if the radio-carpal joint is not involved in the arthritic process, although it would appear that this more localized type of operation is not so effective in relieving pain or in the return of power to the wrist and hand as a whole. In cases of osteoarthritis of the carpo-metacarpal joint of the thumb, fusion with the thumb in the grasp position gives a very satisfactory functional result in addition to complete relief from pain.

Arthrodesis of the elbow or shoulder.—In actual practice, arthrodesis of either the elbow or shoulder joint is only occasionally required in osteoarthritis. Should this be the case, the position for maximal function is that described by Capener (1950).



(*a*) (*b*)

FIG 2—(*a*) Osteoarthritis of the shoulder, (*b*) same case as in (*a*), showing three-flanged nail for internal fixation—intra-articular arthrodesis

In performing arthrodesis of the shoulder (Fig. 2), a useful method is to use internal fixation by means of a short three-flanged nail driven through the humeral head into the scapula, after erasing the articular cartilage from the head of the humerus and the glenoid. Alternatively, a graft can be used as in the method described by Brittain (1941), extending from the region of the humeral tuberosity to the scapula. Turning down part or the whole of the acromion process on to the humeral tuberosity, as described by Watson-Jones (1938), also helps in obtaining sound fusion of the shoulder joint and can easily be combined with internal fixation.

Osteotomy

Osteotomy has been used mainly in treatment of osteoarthritis of the hip, and was advocated particularly by McMurray (1936). The femur is divided in the subtrochanteric region, and the upper end of the shaft must be displaced below the edge of the acetabulum In order to ensure union between the upper and lower portions of the femur, Roaf (1951) has recently been inserting a three-flanged nail across from the greater trochanter into the distal portion of the femur (Fig. 3) This not only acts as an internal fixation, but also has been used in an attempt to avoid prolonged

plaster immobilization, which is required unless some such form of internal fixation is used. McMurray (1949) claimed that this operation relieves pain and deformity without loss of stability, and does not produce strain on the lumbar spine. If the proximal and distal fragments fail to unite, pain and disability are likely to recur, and one criticism of this line of treatment is that reconstruction from this stage, whether in the form of an arthrodesis or of an arthroplasty, is a most difficult problem.

Arthroplasty

Arthroplasty of the hip.—In recent years, mainly owing to the work of Smith-Petersen (1939), arthroplasty of the hip in the treatment of chronic arthritis has received a great deal of attention (Badgley, 1946; Bickel, 1950; Bickel and his colleagues, 1944; Law, 1948b; Smith-Petersen, Aufranc and Larson, 1943 and 1945).

Indications.—In cases of bilateral osteoarthritis of the hip, or of osteoarthritis of the hip associated with similar changes in the knee joints or in the lumbo-sacral



Fig. 3.—Upper femoral osteotomy with internal fixation of proximal and distal segments by means of a three-flanged nail.

spine, there is a clear indication for maintaining movement in the joint concerned, in addition to relieving pain and maintaining stability. Therefore, for many elderly patients, it is desirable to carry out some form of hip-joint reconstruction in which a prolonged plaster immobilization is not essential, so as to avoid the danger of prolonged recumbency, with consequent chest complications, or stiffness of the adjacent joints, particularly the knee.

Undoubtedly the most ideal subject for treatment by arthrodesis or osteotomy is also the best for arthroplasty. The surgeon must treat each case on its own merits, taking into consideration his own choice and experience and, in particular, the patient's powers of co-operation in the after-treatment, which for arthroplasty is most important.

Technique of vitallium mould arthroplasty.—The essential points of the Smith-Petersen vitallium mould arthroplasty operation (Figs. 4 and 5) are as follows (Smith-Petersen, 1939; Smith-Petersen and Law, 1947).

(1) A wide exposure of the hip joint, with a minimum of trauma to the surrounding muscles. Smith-Petersen himself has developed the anterior approach to the hip joint, and it is to be noted that the muscles are stripped from both sides of the iliac crest in order to release the iliopsoas for medial retraction, so as to give a clear view of the acetabulum. Gibson (1950) has advocated the postero-lateral approach, with the turning upwards of the greater trochanter and its attached muscles, and approaching the hip joint from the back This, too, gives a very easy and wide exposure of the joint, and also makes it simpler to transpose the trochanter downwards if this should be desired. Many surgeons are using this approach in preference to the anterior Smith-Petersen approach because of the wide exposure, but it may not be quite so easy to reconstruct the acetabulum accurately, viewing it postero-laterally.

(2) Smith-Petersen has stressed the very accurate reshaping of the femoral head and the acetabulum at the level of healthy bleeding bone. This is achieved by the use of special



Fig 4 —Bilateral osteoarthritis of the hip joints.

gouges and reamers, which give not only smoothness but congruity. In the process of this reshaping, the acetabulum is deepened to the inner pelvic cortex very frequently, and this also tends to relax the tightness of the adductors and provides sound stability, bringing the axis of weight-bearing closer to the line through the centre of gravity of the body.

(3) The vitallium mould is so fitted on the femoral head and in the acetabulum that it moves freely on both, and yet retains its stability. The purpose of this mould is to [illegible]

occur with stainless steel.



FIG. 5—Same case as in Fig. 4—vitallium mould arthroplasty Note the depth of the acetabula, the margins of the mould clearing the acetabulum without impinging on the trochanter. Also note the valgus relationship.

(4) It is helpful to prevent new-bone formation at the margins of the raw bone surfaces if these are coagulated by diathermy prior to suturing the muscles. It is also important to remove all bone dust and tiny bone fragments from the operation site, by irrigation and suction, for they, too, will tend to result in new-bone formation.

After-treatment in arthroplasty—The after-treatment is most important, and the patient should be kept under supervision for a minimum of two years after the operation.

For the first 3–4 weeks after operation, the patient is partially immobilized on a Thomas or a Hodgen splint with a Pearson knee attachment, using skin traction with a light weight of some 5–7 pounds in balanced suspension During this period, static exercises are carried out at regular intervals, particularly for the quadriceps and gluteal groups, and after the first 2 weeks gentle knee-joint and hip-joint assisted exercises on the splint are carried out by the physiotherapist. Too much movement of the hip in these early stages is harmful in that it disorganizes the haematoma and produces a mass of adhesions in the joint. The patient during this time should sit up and lie flat for alternate periods so as to avoid a flexion deformity. This period of light traction is followed by 2 more weeks in bed, when active mobilization of the hip is commenced For this purpose, the use of roller-skates on a hinged board, to provide abduction and adduction exercise, is beneficial. The patient also is encouraged in straight leg-raising exercises, and assisted and even resisted exercises if the musculature should allow. Exercises in the prone position are also advised, to counteract any tendency to a flexion deformity.

After the fifth or sixth week, the patient is allowed to get up, and walks with partial (really subtotal) weight-bearing by the use of crutches. The use of crutches is important in that the new joint is protected while the cancellous bone is still soft and organizing Excessive pounding of the joint at this early stage will only result in disorganization and recurrence of the osteoarthritic degeneration

After about the third month, the patient usually has strong enough musculature to allow sticks to replace the crutches, and after a further month or two a single stick will

replace the double sticks. During this ambulatory period, the use of the stationary bicycle, sideways and forwards jumping exercises, Guthrie-Smith sling exercises, stair-climbing exercises and the swimming pool are all excellent forms of rehabilitation Where there are a number of these cases being treated together, group therapy is excellent, providing the extra stimulus of competitive effort.

The individual patient's progress is related to the return of power in the gluteal and quadriceps muscle group, in particular. The essence of this after-treatment programme, therefore, is active exercise, but if individual muscle groups are somewhat sluggish, faradism is a useful supplementary method of treatment, as also are heat and massage if the muscles become sore or easily fatigued after exertion. If the patient is not willing to undertake this post-operative programme, some other form of operative procedure will have to be carried out, for the after-treatment in arthroplasty is as important as the operation itself.

Bilateral arthroplasty of the hip.—In cases of bilateral osteoarthritis of the hips, the arthroplasty of the second hip may be carried out as soon as 2–3 weeks after the first, if both hips are equally involved; but if one hip is much more severely involved than the other, it is best to treat the case as a single-hip problem, and to operate on the second hip only when this becomes essential at a later date. On the whole, operation on the single hip gives a better result than does operating on the two hips with a short interval between the procedures, although in such a case only one rehabilitation period is required. Unfortunately, a large number of patients present for treatment only when both hips are severely disorganized; such cases require bilateral reconstructive treatment for the relief of pain, correction of deformity, and the restoration of adequate function.

Arthroplasty in cases due to congenital dislocation.—In cases of old congenital dislocation of the hip with secondary osteoarthritis, difficulty in joint reconstruction may be encountered owing to the severe degree of anteversion of the femoral neck. This frequently amounts to almost 90 degrees, and in such cases a preliminary rotation osteotomy is necessary. This is carried out in the subtrochanteric region, and internal fixation is usually employed either in the form of a vitallium plate and screws or of a Kuntscher intramedullary nail It is possible to carry out the osteotomy and joint reconstruction at the same operation, although occasionally the osteotomy is slow in uniting; such a complication would then interfere seriously with the rehabilitation of the joint.

Complications in arthroplasty of the hip

In a series of 217 cases (273 hips) of osteoarthritis treated by arthroplasty (Law, 1952), the complications which occurred are listed in Table I.

Infection.—As a prophylactic against infection at operation, penicillin and streptomycin are introduced into the wound locally, and the patient is treated systemically for 72 hours.

In this series, all the superficial infections healed satisfactorily under local treatment and chemotherapy; but in the 2 cases of deep infection, when the sinus track extended down to the mould or joint, one patient required a revision of the arthroplasty with excision of the sinus and removal of the mould, whereas the other healed after prolonged chemotherapy and further immobilization. The case in which the mould was removed showed new joint surfaces which were adequately re-formed, a year having been allowed to elapse between the original operation and the revision, and therefore a very satisfactory arthroplasty resulted.

Thrombophlebitis.—In elderly patients, recumbency in bed is always apt to be complicated by thrombophlebitis. This complication is likely to be prevented by avoiding the use of excessively heavy retraction of the soft tissues at operation,

TABLE I

COMPLICATIONS FOLLOWING OSTEOARTHRITIS TREATED BY ARTHROPLASTY

Complication	*Early*	*Intermediate*	*Late*
Superficial infection	8	—	—
Deep infection	—	2	—
Thrombophlebitis	—	3	—
Pulmonary embolism	—	10 (4 deaths)	—
Post-operative chest	5	—	—
Subluxation	—	4	—
Dislocation	5 (revised)	1	—
Adhesions	—	—	6
Excess new-bone formation	—	—	3
Mould impingement	—	—	1
Sciatica	—	—	3
Crutch palsy	—	1	—

Early complications are those appearing during the first 2 weeks after operation; intermediate are those appearing between two weeks and two months, and late are those seen during the next two years or longer.

and of tight restrictive dressings, such as the spica bandage. The use of static exercises and free movement of the patient in bed also help in preventing this complication.

Pulmonary embolism.—Closely linked with thrombophlebitis is the danger of pulmonary embolism, which has been the recorded cause of death in 4 cases, and was the only cause of death in this series. The other cases responded to rest, heparin and dicoumarol therapy, and the continued systemic administration of penicillin.

Chest complications, such as pleurisy or pneumonia, appear extremely rarely (as the figures show) and mildly, in spite of the majority of these patients being elderly. In this respect, no doubt chemotherapy has also given valuable prophylaxis.

Subluxation; treated by manipulation.—When the femoral head has subluxated from the mould or the mould partly displaced from the acetabulum, treatment by manipulative reduction, with or without anaesthesia, has proved most successful; it should be followed by a short period of immobilization of some 2–3 weeks, so as to allow the new articular capsule time to organize more completely. This complication is more likely to occur in patients who, prior to operation, had a severe external-rotation deformity, and the residual contracture of the external rotators of the hip is difficult to overcome completely. Complete dislocation after arthroplasty may result from faulty handling of the patient in the early post-operative stages, but is much more likely to be the result of leaving a ridge of hypertrophic bone posteriorly in the acetabulum, or of not making it sufficiently deep. In such cases, an operative revision, with enlargement and increase in depth of the acetabulum, is essential.

Adhesions, treated by manipulation.—Diminution in the range of movement, instead of a steady increase over the first 12 or 18 months after operation, will result from adhesions within the joint, or sometimes from excessively tight adductor-muscle origins. In these cases, a gentle manipulation under anaesthesia, which may be repeated if necessary, combined with tenotomy of any tight muscle bands, is helpful.

New bone.—New-bone formation, too, around the joint, will result in diminution or loss in the range of movement. Very occasionally a patient will react to this type of operation with a condition resembling myositis ossificans, which converts the arthroplasty into an arthrodesis. In such cases, provided that there is no pain or fixed deformity, the stiffness can be accepted; but if the disability persists, treatment

by revision, in which the arthroplasty is performed a second time, may be effective. In a number of cases the new-bone formation is extra-articular and even extra-capsular, resulting from the sub-periosteal stripping of the muscles on the ilium. Such new-bone formation does not interfere with joint function and should cause no complications. An accurate wound closure should prevent or lessen this complication.

Absorption of the femoral head.—If the arthroplasty is performed at the level of unhealthy bone, or if too tight a mould is used, absorption of the femoral head within the cup will occur. This in itself may be painful, or impingement of the margins of the mould on either the greater or lesser trochanters will cause pain, probably the result of irritation of the periosteal nerve-endings. In such cases, provided that the joint surfaces have re-formed satisfactorily, the mould may be removed, or it may be changed for one of a different depth and diameter. In addition, a relative lengthening of the femoral neck can be obtained by transposition of the great trochanter and its attached muscles down the femoral shaft. This can be carried out either as a primary or as a secondary procedure, and may also be helpful in restoring the gluteal power, and thereby overcoming the positive Trendelenburg dip during weight-bearing. On this account, some surgeons prefer to transplant the trochanter and the attached gluteal muscles as a routine procedure in the operation.

Post-operative shock.—The patients' ages in this series varied between the ages of 25 and 80 years, but, owing to routine blood transfusion at operation and careful anaesthesia (usually a Pentothal induction followed by gas, oxygen and curare), there have been no severe cases of post-operative shock. In 2 or 3 cases, when oozing has continued from the large raw bone area, further transfusion during the first week after operation has been required to raise the haemoglobin level.

Sciatica.—In addition, there have been 3 cases in which sciatic pain has occurred after the period of post-operative traction. It has been extremely difficult to determine the cause. There were associated osteoarthritic changes in the lumbar and lumbo- [illegible] of osteoarthritis of the hip and associated osteoarthritis of the lumbo-sacral spine, may necessitate the wearing of some low-back support, such as a Goldthwait belt, at least in the early stages of ambulation.

Results of arthroplasty

Relief of pain.—The most striking feature in the series of Smith-Petersen's cases, which were reviewed some 5 years ago (Smith-Petersen and Law, 1947), and in the series of cases under review (Law, 1952), is the diminution in joint pain. Some soreness and aching in the muscles, particularly when they are fatigued, is experienced by most patients; but the severe boring type of articular pain, which is such a characteristic feature of osteoarthritis, is lost in practically every case. The result is that these patients can sleep and sit in comfort, and they lose their somewhat haggard facial expression, which is also a constant feature of the arthritic patient in pain. The reasons for this diminution in pain would appear to be the excision of the capsule and its associated pain nerve-endings, in addition to the restoration of a joint which is more mechanically perfect, the surfaces being again smooth and congruous.

The range of movement regained varies considerably in individual patients, and the average for the series is shown in Tables II and III.

It would appear that the range of movement is influenced more by the pre-operative deformity and stiffness than by age, although the younger patients develop muscle power more quickly, and are more speedy in their transition from crutches to walking-

TABLE II

MOULD ARTHROPLASTY IN UNILATERAL OSTEOARTHRITIS OF THE HIP

	Number of cases	*Average age*	*Flexion*	*Abduction/ Adduction*	*Rotation*
Primary	109	65 years	80°	35°	20°
Secondary Congenital dysplasia	17	35 years	85°	40°	25°
Trauma	7	54 years	70°	40°	35°
Perthes' and slipped epiphysis	17	37 years	90°	40°	25°
Otto pelvis	5	53 years	50°	30°	20°
Bone disease	6	47 years	80°	30°	20°

TABLE III

MOULD ARTHROPLASTY IN BILATERAL OSTEOARTHRITIS OF THE HIP

	Number of cases	*(Hips)*	*Average age*	*Flexion*	*Abduction/ Adduction*	*Rotation*
Primary	35	(70)	57 years	50°	39°	15°
Secondary Congenital dysplasia	12	(24)	36 years	60°	30°	30°
Trauma	1	(2)	39 years	45°	35°	25°
Perthes' and slipped epiphysis	3	(6)	51 years	60°	45°	20°
Otto pelvis	3	(6)	50 years	40°	20°	15°
Bone disease	2	(4)	54 years	65°	45°	10°

sticks, and to walking unaided. The return to everyday activities, such as stair-climbing, putting on shoes and stockings, getting in and out of a bath, and car-driving, is most satisfactory. Bilateral cases show a slower recovery rate, and the patients are more likely to require a stick permanently for outdoor walking. They usually gain less movement, and therefore find such activities as tying their shoes more difficult; but as a rule they are able to climb stairs, sit in comfort on a fairly low chair and drive a car quite easily. In several cases, the transformation from a scissors type of gait to walking and sitting with the lower limbs in a more normal

position is most marked, and is appreciated by the patient as much as the relief from pain. As a rule, the flexion—adduction—external-rotation deformity is very largely corrected, but some true shortening may persist in virtue of the diseased bone which has been removed. This rarely amounts to more than $\frac{1}{2}$–$\frac{3}{4}$ inch. In cases of osteo-arthritis secondary to congenital dysplasia, there is frequently a gain of leg length, in some cases amounting to as much as 2 or $2\frac{1}{2}$ inches, the acetabulum being reconstructed as near to the anatomical level as possible.

The Judet operation

Technique

The brothers Judet have developed this operation during the past 5 years (Judet and Judet, 1950), it consists in replacing the femoral head by an acrylic prosthesis (Fig. 6) The joint is exposed through either the anterior or the postero-lateral approach and, after incision of the capsule and dislocation of the joint, the femoral head is removed at the cervico-capital junction A central channel is then made down the cancellous bone of the femoral neck to the base of the trochanter, and the stump of the neck is also smoothed and rawed, using special instruments. The prosthesis is then fitted by driving the centre pin down the channel in the femoral neck, and the rim of the acrylic head fitted tightly on to the stump of the femoral neck. The size of prosthesis chosen is one which is slightly smaller than the original femoral head, and which moves freely and smoothly in the acetabulum. The acetabulum itself is smoothed, using a light reamer, but is not reconstructed to the same extent as in the Smith-Petersen operation. This operation may have a special place in the treatment of traumatic arthritis of the hip following femoral-neck fracture, particularly when there is non-union or avascular necrosis of the femoral head. There is no need for the accurate reshaping of raw bone surfaces, such as is required in vitallium mould arthroplasty Therefore the operation may be applicable in osteoarthritis to patients in whom the acetabulum is not too much disorganized, or when, for constitutional

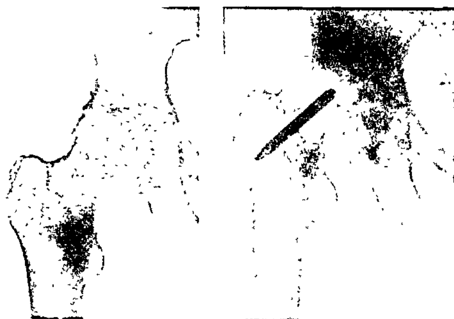


FIG. 6 —Osteoarthritis of hip treated by the Judet acrylic prosthesis for the femoral head.

reasons, the more major arthroplasty operation is contra-indicated yet a capsulectomy or neurectomy would be insufficient.

Results and indications

The long-term results of the Judet operation naturally must be investigated with care in due course, but the immediate results appear to be encouraging, and the technique certainly worthy of further trial. The after-treatment programme, although basically the same as that described for arthroplasty of the hip, is a little shorter, in that the period of immobilization is as short as 2 weeks, with a further week or 10 days of mobilization in bed prior to the patient's being up on either crutches or walking-sticks.

At the present time it would appear that the more advanced cases of osteoarthritis of the hip demand a more complete reconstruction of the femoral head and acetabulum, particularly the latter, than is usually done in the Judet operation. Therefore these cases should be treated by the mould arthroplasty. On the other hand, if the femoral head has to be sacrificed completely, the Judet operation is a more simple procedure than the modified Whitman type of operation or the modified Colonna or intra-trochanteric arthroplasty, which are the alternative mould-arthroplasty operations.

Pseudo-arthrosis of the hip

In recent years the pseudo-arthrosis operation introduced by Jones and Lovett (1923) has been replaced either by excision of the femoral head (Girdlestone, 1928) or by *excision of the femoral head combined with a reversed osteotomy* (Batchelor, 1948). These operations, on the whole, restore movement at the cost of some stability, and, although they appear to relieve pain in the early stages, the incongruity of the surfaces does tend to produce some secondary degenerative changes with the passage of time (Fig 7). The use of a walking caliper, either temporarily or permanently, may also be required, but in the difficult group of cases of osteoarthritis secondary to protrusio acetabuli, in many instances the pseudo-arthrosis operation may produce the best result with regard to general function. The stability of the hip after a pseudo-arthrosis is greater in the rheumatoid type of case than in the osteoarthritic type. Many surgeons, therefore, prefer this type of operation for rheumatoid arthritis, rather than one of the more formal kinds of arthroplasty.



Fig. 7.—Batchelor type pseudo-arthrosis.

Choice of procedures for osteoarthritis of the hip

Summarizing the present-day methods of treatment in osteoarthritis of the hip, *particularly as regards restoring movement* in addition to relieving pain and maintaining stability, there is no doubt that the vitallium mould arthroplasty has effected considerable progress and stimulated great interest in this aspect of the problem. With the choice of operative procedures

available, there is no need for these patients to be doomed to complete invalidism, as was so frequently the case in the past, and it is most important both socially and economically that these patients be given some degree of independence in addition to being relieved of their pain and deformity.

Arthroplasty of the knee

Compared with the hip, the problem of arthroplasty of the knee is an extremely difficult one, because the hinge-like mobility in one plane cannot easily be retained or regained without losing stability in the other plane. The indication for attempting arthroplasty of the knee in osteoarthritis is in a joint which is painful and either completely or partially ankylosed in association with involvement of either the other knee or the hip joints. The reconstruction of the femoral and tibial condyles in arthroplasty of the knee may follow one of three lines:

(1) The Campbell (1924) technique, constructing a single broad femoral and tibial condyle

(2) The formation of a tibial spine, together with the reshaped condyles (Putti's technique).

(3) Making wedge-shaped femoral condyles, which actually increase the incongruity of the articular surfaces (Haas' technique)

It is important to remove an adequate amount of bone from the posterior part of the femoral condyles, so as to allow movement of the tibia on the femur in flexion. The cruciate ligaments are sacrificed, but the collateral ligaments and the joint capsule are preserved as carefully as possible It would appear that the interposition of either fascia, metallic substance or (even more recently) nylon, is secondary in importance to the reconstruction of the bone ends. It is rarely possible to obtain more than 90 degrees of movement in an arthroplasty of the knee without a severe loss of stability or valgus deformity In spite of a good deal of grating in knees treated by arthroplasty, pain as a rule is not marked, even in the presence of the somewhat bizarre appearances of the femoral and tibial condyles.

In a follow-up study of arthroplasty of the knee from the Campbell Clinic, it was noted that the function reached its maximum after 5–10 years, and remained remarkably stable in contrast to what happened with fascial arthroplasty of the hip (Campbell, 1939).

In Great Britain, arthroplasty of the knee has not progressed much beyond the experimental stage, and the principle of providing painless stability in weight-bearing joints applies very much to the knee, for which joint arthrodesis has been, and is still, widely practised, whether single or bilateral joint involvement is present.

Other operations on the knee

Excision of the patella has been practised to a considerable extent where osteoarthritis has been present mainly between the patella and femoral articular surfaces. Although it has been claimed that the immediate results are good, there is no indication by means of a detailed follow-up study that such an operation prevents osteoarthritic changes occurring later in the tibio-femoral joint compartment.

Synovectomy. In osteoarthritis synovectomy is useful only in the so-called "wet" stage of the disease, when the joint is prone to recurrent effusions, resulting in pain and instability prior to gross destruction of the articular cartilage or to much hypertrophic change. The number of cases, therefore, which are suitable for synovectomy is small, because in the past they have not presented for this type of treatment at the right time. If synovectomy is carried out too late, an incompletely ankylosed joint will result, with pain and considerable disability. Clearly it is far better in this type of case for an arthrodesis to be performed, which provides painless stability.

Operations on the ankle

Arthroplasty is never attempted in the ankle joint, where a sound arthrodesis gives a perfect result, provided that the subastragaloid and midtarsal joints are freely mobile.

Rheumatoid Arthritis

COMPARISON WITH OSTEOARTHRITIS AND ANKYLOSING SPONDYLITIS

Both rheumatoid arthritis and ankylosing spondylitis have characteristic features in direct contrast to the appearances in osteoarthritis, and these also have a direct bearing on the methods of surgical treatment. The involvement of multiple joints, the tough fibrous or bony ankylosis and the atrophic changes in the bones themselves all are characteristic features which add to the problems of surgical reconstruction, in addition to difficulties resulting from the marked degree of periarticular fibrosis in the soft tissues, and to the muscle wasting.

CONSERVATIVE TREATMENT

The principle of conservative treatment, so lucidly described by Capener (1950) as physiological rest, is still necessary in the acute painful stage of the disease, and the work of Hench and Kendall at the Mayo Clinic, in the production of cortisone, *may effect a revolution in the treatment of these cases of rheumatoid arthritis in the* early stage.

Treatment with cortisone

There is no doubt that cortisone produces dramatic results in many cases treated in the acute phase, but Hench himself emphasizes the rebound relapse which follows the withdrawal of cortisone (Hench and his colleagues, 1949 and 1950). Mistakes of this kind can be averted only by gradually tapering off the dosage. The dramatic response to cortisone is shown by the increase in appetite, gain in weight, relief from pain and improvement in joint and muscle function, in addition to the fall in the [illegible] cortisone by intramuscular injections, [illegible] by 8-hourly injections, [illegible] s for 2 days, followed [illegible] to reduce the dose to [illegible] twice weekly or even weekly.

Complications of therapy.—Complications which must be expected while carrying out cortisone and ACTH therapy include the following.

(1) The Cushing type of syndrome with water retention. This is likely to regress quickly on cessation of the therapy.
(2) Arterial hypertension, which may be either (a) benign or (b) malignant with cardiac failure.
(3) Diabetes mellitus.
(4) Psychotic change—probably aggravated by the reaction to improvement in the arthritic condition while under treatment, followed by recurrence of joint disturbances when the treatment is terminated.
(5) Peptic ulceration with liability to perforation.
(6) The exacerbation of tuberculosis.

Local application combined with surgical operation.—Cortisone has also been used locally, particularly in the knee joint, 50 milligrams being inserted at arthrotomy with partial synovectomy. After an initial reaction with effusion, relief of pain and associated muscle spasm are claimed. In the few cases already treated surgically in which cortisone therapy has been tried, little change in the condition of the individual joints has been noted, though the patient's general condition may have improved (Johnson, 1951).

Immobilization

The basis of conservative treatment is immobilization, which is effective in relieving pain; but it is most important to stress the fact that this immobilization should not be carried to a point where it makes surgical treatment more difficult. Prolonged immobilization will result in muscle atrophy, loss of ligamentous elasticity, bone atrophy and joint degeneration, which is aggravated by continuous apposition of the joint surfaces instead of the normal intermittent pressure and friction, as is pointed out by Smith-Petersen (Smith-Petersen, Aufranc and Larson, 1943)

SURGICAL TREATMENT

Effects of muscle spasm

In the upper extremity, if one joint is involved in the rheumatoid process, the surrounding muscle spasm also affects the adjacent joints, producing a deformity of the whole limb. Thus the shoulder adopts a position of adduction and internal rotation; the elbow is flexed with limitation of pronation and supination; the wrist is flexed palmarwards, and deviates to the ulnar side, as do the interphalangeal joints of the fingers.

Rheumatoid arthritis in the shoulder

Smith-Petersen has drawn attention to the effect of muscle spasm in rheumatoid arthritis involving the shoulder joint (Smith-Petersen, Aufranc and Larson, 1943). Secondary subacromial and subdeltoid bursitis result in gross interference of scapulothoracic movement, in addition to considerable pain, which can be relieved only by the acromioplasty or acromionectomy operation.

Treatment by acromionectomy—By excising the acromion process, the central tendon of the deltoid muscle is brought into contact with the tendinous cuff, which is no longer trapped underneath the bone, so producing severe pain and thereby limiting all upper-limb movement and function. A bayonet-shaped incision is used, starting in front of the anterior angle of the acromion and extending to behind the posterior angle of the acromion The periosteum between the origin of the deltoid and the insertion of the trapezius is incised, and the muscles are stripped subperiosteally The acromion can be removed through the acromio-clavicular joint or divided by an osteotome just lateral to it The congested villous subacromial bursa is completely excised, exposing the tendinous shoulder cuff, which can also be repaired if it is frayed and torn In the wound closure it is important to suture the central tendon of the deltoid muscle to the periosteal attachment of the trapezius, so as to avoid muscular weakness.

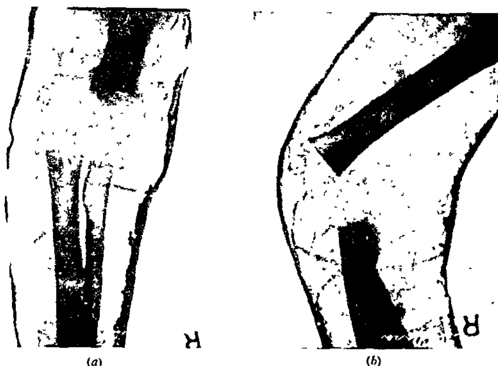
Rheumatoid arthritis of the elbow

When the elbow joint is involved in rheumatoid process, all movement is limited, and spasm of the biceps muscle in particular is evident. This spasm may be so severe

as to produce a deficiency in the alignment between the radial head and the capitellum, and Smith-Petersen has reported on cases in which a sulcus or depression in the articular surface of the capitellum has been caused by the inferior articular margin of the radial head (Smith-Petersen, Aufranc and Larsen, 1943).

Elbow reconstruction

This is the reasoning, therefore, behind his advocacy of excision of the radial head, together with a subtotal synovectomy of the joint, in order to relieve pain and restore joint movement. Really this is an operation which must be performed early rather than late, when advanced destructive changes would have occurred on all the joint surfaces.



(*a*) (*b*)

Fig. 8.—Arthroplasty of elbow (*a*) Antero-posterior and (*b*) lateral skiagrams taken through plaster

When the elbow joint has been completely disorganized, or has undergone ankylosis in a bad functional position, movement and improved function can be obtained by arthroplasty of the excision type (Fig. 8), in which the lower end of the humerus and the upper end of the radius and ulna are excised, as in the classical excision operation. It is important to resect an adequate amount of bone both proximally and distally, for otherwise re-ankylosis is extremely liable to occur. The other type of arthroplasty operation, in which the lower end of the humerus is shaped to articulate with an enlarged fossa of the upper end of the ulna (Campbell, 1939), is not suitable for rheumatoid arthritis, owing to the likelihood of re-ankylosis. This type of operation, however, may be used in osteoarthritis of the elbow, and it gives a greater degree of stability.

Rheumatoid arthritis of the wrist

In rheumatoid arthritis of the wrist, it is important to restore the position of function of the hand, which is the so-called "grasp position". In addition, it is highly desirable to restore some degree of pronation-supination movement of the forearm,



FIG. 9.—Rheumatoid arthritis of the wrist treated by excision of the lower end of the ulna and radio-carpal fusion.

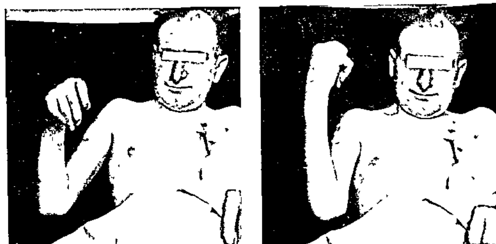


FIG 10.—The degree of supination and pronation obtained after excision of the lower end of the ulna and radio-carpal fusion. This is sufficient for such important uses as opening doors and doing needlework Note also the adduction deformity of the shoulder.

if this is at all possible It can be achieved by arthrodesing the wrist and excising the lower end of the ulna (Figs 9 and 10).

Reconstruction of the wrist.—This, too, is an operation devised by Smith-Petersen, based on Darrach's approach to the lower end of the ulna (Smith-Petersen, Aufranc and Larson, 1943). In cases of derangement of the inferior radio-ulnar articulation, a bayonet incision over the lower end of the radius and the ulnar margin of the hand is [illegible]

enables pronation and supination of the hand, should be carried out before there is gross flexion and ulnar-deviation deformity at the carpus, and a secondary similar

deviation and deformity in the metacarpo-phalangeal and interphalangeal joints. These constructive procedures are indicated before the disease process is far advanced, and they are particularly useful for the relief of pain, even though the range of movement may not be markedly improved.

Osteotomy of the spine in ankylosing spondylitis

The rigid thoracic kyphosis

Sometimes in rheumatoid arthritis, and frequently in ankylosing spondylitis, the patients develop a rigid flexion deformity of the spine, aggravated partly by recumbency and partly by flexion deformity in the hip joints. This spinal deformity is the result of fibrosis and contracture, followed by calcification and ossification in the long and short ligaments of the spine, and in the capsules of the intervertebral articulations. In the more advanced cases of ankylosing spondylitis, the spine is a solid mass of bone from the occiput to the sacrum, with flattening of the cervical and lumbar lordoses and a marked exaggeration of the thoracic kyphosis. Such a patient may find it extremely difficult to see ahead and, in addition, have difficulty with respiration and suffer from gastro-intestinal symptoms due to pressure of the costal margin on the abdominal viscera. The costo-vertebral joints also undergo this ankylosis, and the patient depends entirely on diaphragmatic movements for respiration. Any restriction of the diaphragmatic movement, therefore, is a severe handicap.

Immobilization and manipulation

In the earlier stages, corrective plaster jackets or immobilization in a plaster shell may bring about some improvement in the dorsal kyphosis. In other cases manipulation, followed by the wearing of a spinal support, will enable the patient to improve the deformity; but once bony ankylosis has occurred in the articular facets and in the longitudinal ligaments, such conservative treatment is useless.

Technique of spinal osteotomy

Level of osteotomy.—Spinal osteotomy is always carried out in the lumbar region on account of the relatively wider spinal canal, and because there is less likelihood of causing danger to the cauda equina than to the cord proper. In addition, in the thoracic region, the fused costo-vertebral joints make correction impossible. The level chosen at which to carry out an osteotomy is the one where the ossification in the anterior longitudinal ligament, or in the interlaminar and interspinous ligaments, is least marked.

Anaesthesia.—Intubation of these patients for anaesthesia may be a most difficult or even hazardous procedure on account of the rigid flexion deformity at the cervico-thoracic level. If the operation is to be carried out with the patient in the prone position, intubation is desirable, although not absolutely essential, and an operation table which will break in both directions is of great value. The operation field is also cleared considerably by a preliminary infiltration with local anaesthetic, such as amethocaine combined with a few minims of 1 1,000 adrenaline.

Incision and resection.—The lumbar spinous processes are exposed by an incision in the midline, and the muscles are stripped laterally by subperiosteal dissection as far as the articular processes. This exposes the ossified interspinous and interlaminar ligaments, which must be resected at the level chosen for the osteotomy, although, before the ligamenta flava are resected, the spinous process below is removed, leaving a shelf of bone only at its base. The ligamenta flava, whether they be fibrous or osseous, are removed completely, exposing the theca, and then a guide, such as a small periosteal elevator, can be introduced from the vertebral foramen into the intervertebral

[illegible] the osteotomy. [illegible] to penetrate [illegible] ion field. The osteotomy is carried out at an angle of about 45 degrees to the frontal plane, through the superior articular process of the vertebra below and the inferior articular process of the vertebra above on each side, and for this purpose narrow-bladed osteotomes and gouges, bone-nibbling forceps and rongeurs are extremely useful. The osteotomy is made on both sides at one or more levels, or the whole operation may be performed in one or more stages at one or more levels. The actual osteotomy line should be



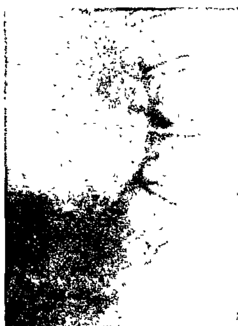


FIG 11 —Ankylosing spondylitis Pre-operative severe rigid dorsal and lumbar kyphosis

almost ¼ inch wide, so as to allow free movement in the course of the correction and, when correction is terminated, these osteotomy lines are completely closed.

Correction —This is achieved by raising the head and the foot ends of the operation table, so as gradually to extend (and even hyperextend) the back under complete control. At the end of this correction, the osteotomy spaces are closed, and the base of the spinous process above is impacted on to the shelf of bone below, remaining from the base of the spinous process, which has been previously resected. The obliquity of the osteotomy lines gives lateral stability, and antero-posterior stability is achieved by this final position of the spinous process on the shelf of bone. In the course of the hyperextension, the anterior longitudinal ligament will snap, and if it is osseous there will be an audible and palpable break. If the ligament is still fibrous, its rupture will be felt as a soft thud, and it is at this point in the operation that the surgeon must have complete control of the extension manoeuvre.

Fusion —Following the correction, a modified Hibbs type of fusion can be carried out, raising up bony flaps from the adjacent laminae, and packing in cancellous bone chips made from portions of previously resected bone If it is desired, internal fixation by means of plates or wires can also be used, but fusion is usually very readily achieved

in cases of ankylosing spondylitis. It is important to suture the muscles firmly prior to closure of the skin.

Post-operative care.—The patient is nursed on a plaster shell or in a plaster jacket, which also includes one thigh. This makes turning easier for nursing purposes, and gives a more efficient immobilization. After 4–6 weeks, an ambulatory plaster jacket can be worn and, once bony consolidation has occurred (usually after about 3 months), a spinal brace can be used in lieu of the plaster jacket. This support should be worn



Fig. 12.—Spinal osteotomy. Stage 1 correction. (L3–4 spinal osteotomy).

for about a year while the patient is undergoing spinal-extension exercises to re-develop the tone of the long spinal muscles. In addition to these spinal exercises, breathing exercises are most important, and also play a part in preventing recurrence of the deformity.

Results of spinal osteotomy

This operation is a difficult one, and must not be undertaken lightly, although it can be most dramatic in its results. The patient is benefited in four ways.

(1) The patient is enabled to see ahead and in front.

(2) By relieving the pressure of the costal margin on the abdomen, the diaphragmatic respiration is freed.

(3) Troublesome indigestion, due to pressure of the costal margin on the upper abdominal viscera, is also overcome.

(4) The patient gains a great deal cosmetically, and the whole body is placed in a better position for function. This also benefits the patient's morale considerably.



FIG. 13 —Final appearance after second stage correction (Second stage L1–2 correction with first stage L3–4 correction satisfactorily maintained for over one year.)

Complications of spinal osteotomy

Fatalities.—In a series of some 30 cases, there have been 3 deaths (Law, 1952). The first was the result of a nursing accident in which the patient was turned prone for nursing purposes, and then slipped down in the bed; on account of the rigid cervical spinal deformity, he could not save himself from suffocation in the pillows. These patients, therefore, should never be left unattended when they are prone.

The second death occurred as a result of a fracture dislocation at the cervico-dorsal junction with injury to the spinal cord. The patient died some 4 days after operation, never having really regained consciousness. At necropsy the osteotomy site was found clear of any haemorrhage or injury to the cord, but the cause of the disaster was discovered higher up. This fracture-dislocation may have occurred during the intubation of the patient, or while lifting the patient on or off the operation table, or at the time of doing the osteotomy correction or applying the plaster cast, and is one of the dangers caused by the soft vascular type of bone found in these cases.

The third death was the result of perforation of a large gastric ulcer into the lesser sac of the peritoneum, the patient not responding to gastric intubation. At necropsy there was nothing to suggest that this perforation had resulted from injury at the time of the operation, there being no undue haemorrhage round the osteotomy site anteriorly, although the longitudinal ligament had snapped across quite cleanly. The large vessels were perfectly intact, as were the adjacent psoas muscles.

Non-fatal complications.—There was also one case of dropped foot of a temporary nature, the result of nerve-root distraction This occurred in a patient in whom the degree of osteotomy was altered from 45 degrees to 90 degrees while he was changing into an ambulatory jacket—the reason for this alteration being an inadequate apposition of the spinous process above on to the bony shelf below at the osteotomy site.

In spite of the hyperextension, there have been no cases of severe gastric dilatation, of ileus or of sphincter disturbance, nor has any patient suffered from severe shock, spinal or surgical. There has been no case of injury to the spinal cord, or of haemorrhage into the dura or subarachnoid space, or into the cord itself.

Limitations of correction

Care must be taken not to over-correct these patients' deformities, because, on account of their cervico-thoracic stiffness, they are unable to see downwards adequately for feeding purposes, but, on the other hand, it is advisable to align the axis of thrust of the spine as near the vertical as possible, so as to overcome the natural tendency for forward slumping and recurrence of the deformity. In severe cases, on account of the soft-tissue contracture anteriorly, it may be wise to carry out the correction in a graduated manner, operating in 2 or 3 stages. This operation can be carried out as a sequel to arthroplasty of the hips, or as a preliminary, according to the degree of the deformity and to the length of immobilization likely to be necessary. In some patients the deformed posture is due entirely to the severe flexion deformities of the hips, and correction of these will render any spinal-osteotomy operation unnecessary. There is no contra-indication to performing this operation while the patient is still in the so-called active phase of the disease. The severe deformities which are illustrated here should not be allowed to occur in these more modern days, surgical correction being indicated at the moment when the patient fails to respond to conservative treatment.

Another type of osteotomy

La Chapelle (1946) and Herbert (1948) have also described spinal osteotomy operations designed subsequently to this operation of Smith-Petersen's. They use both a dorsal and an anterior approach, the former being somewhat similar to that already described, and the latter being a division of the ossified anterior longitudinal ligament from the front, using either a transperitoneal or extraperitoneal approach. This second stage of the procedure hardly seems necessary, for no undue difficulty has been experienced in snapping the longitudinal ligament, whether it is fibrous or osseous, although it is advisable to have an operation table which will break in the reverse direction, so that hyperextension can be carried out under complete and absolute control.

Arthroplasty of the hip in rheumatoid arthritis

In rheumatoid arthritis, the hip and knee joints are frequently involved together and separately. On many occasions, the problem of bilateral, painful, stiff hips or knees, or both, has to be faced, and in these cases it is most important that reconstructive surgery should be carried out before fibrosis of muscles and ligaments and atrophy of bones or joint degeneration have progressed too far.

Revisions of vitallium mould arthroplasty

Even then it is essential to realize that a single operation may be insufficient to obtain the desired result, and that one or more revisions of the operation may be required to increase range of movement and enable the muscles to redevelop even further. This is a point which Smith-Petersen stresses most forcibly, with particular reference to vitallium mould arthroplasty of the hip in rheumatoid arthritis and ankylosing

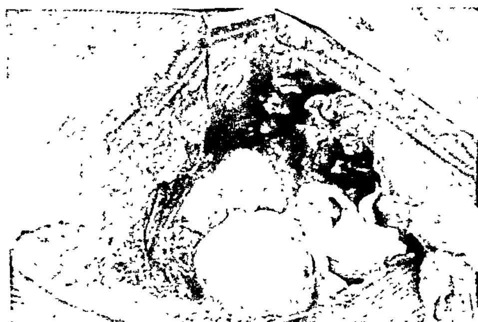


FIG 14—The new fibro-cartilaginous joint surfaces on the femoral head and acetabulum after removal of the mould at a revision operation.

spondylitis (Smith-Petersen, Aufranc and Larson, 1945). Revision of the operation is required for loss of movement, due to bone proliferation, fibrous or bony ankylosis or faulty relationship of the mould, which is apt to be brought about by persistent contracture from fibrosis and muscle spasm, and the atrophic character of the bone.

At these operative revisions, the effects of even limited function in the re-formation of the joint are most striking. The femoral head and the acetabulum are seen to be lined by smooth glistening fibro-cartilage, covered by synovial membrane, and the texture of the underlying bone itself is sound and hard (Fig. 14), in complete contrast with the soft vascular bone which is so frequently found at the first operation in these rheumatoid hip joints. The mould itself remains smooth and gleaming, being quite inert, but of course the hyaline cartilage itself is never regenerated. The appearances of these joints, which are functioning again, give a most striking demonstration of the principle of Wolff's law that "structure is adapted to function". With the vitallium mould or cup, re-ankylosis occurs much less frequently than was the case in arthroplasty of the hip by the use of fascia lata or Baer's membrane. Even with the new

technique, the recurrence of stiffness and deformity is much greater in rheumatoid arthritis and ankylosing spondylitis than it is in osteoarthritis treated by mould arthroplasty. Similarly, if the Judet type of operation is carried out in rheumatoid arthritis and ankylosing spondylitis, the gain in movement and the relief from pain are not so striking as in the traumatic arthritic group. By mobilizing the hip joints in these rheumatoid patients, the muscle tone and power and the ligamentous elasticity in the other joints of the lower extremities is improved, so all the joints may be benefited indirectly by this operation, the response to which is in direct proportion to the degree of muscle wasting and other joint involvement. Although the actual range of movement may be only moderate, the diminution of pain and muscle spasm and the ability to counteract the tendency to contracture in the soft tissues is of very real value to these patients.

Adaptation of technique

There are certain special technical points of importance when performing mould arthroplasty for rheumatoid arthritis or ankylosing spondylitis.

(1) The acetabulum should be made as large as possible consistent with the stability of the mould and the femoral head (Figs. 15 and 16). This enables a large size of cup to be used, and, of course, this mould must be freely movable on the femoral head and in the new acetabulum, congruity being established by means of the special hip gouges and reamers.

(2) The joint capsule and synovial membrane are excised completely, together with the rheumatoid pannus, which creeps over the articular surfaces and margins of the acetabulum and femoral head.

(3) The subchondral bone is soft and vascular, and it is important to have adequate facilities for blood transfusion during the operation, the more so as the initial haemoglobin level may be below normal.

(4) The raw bone margins around the acetabulum and the cervico-capital region of the femoral head are coagulated by diathermy to discourage new-bone formation, which is likely to cause re-ankylosis or distortion of the mould.

(5) The atrophic nature of the bone and the necessity to have very free movement may require modifications of the ordinary arthroplasty operation (Fig. 17), which may be classified as follows (Smith-Petersen, Aufranc and Larson, 1945; Hernaman-Johnson and Law, 1949).

(*a*) *The routine arthroplasty*, in which the femoral head and acetabulum are reshaped, being made smooth and congruous, and the mould is fitted accordingly.

(*b*) *The modified Whitman type of operation* is indicated if the femoral head has so atrophied or the bone is so soft that, in the course of reshaping it by gouging, and more particularly by reaming, the femoral neck is rendered too short. The greater trochanter and its attached muscles are transposed down the femoral shaft, as either a primary or secondary operation, in order to lengthen the femoral neck, over the proximal end of [illegible] to transplant the trochanter and the [illegible]

(*c*) *The modified Colonna operation* is indicated if there is such a severe degree of [illegible] absorption that the femoral head and neck are, in effect, completely lost. The muscles are detached from the greater trochanter, which itself is made smooth and congruous with the acetabulum, a mould being interposed between the two. The trochanteric muscles are attached to the vastus lateralis at its upper end in the region of the vastus tubercle and the lateral aspect of the shaft of femur. Frequently, in order to obtain a greater degree of stability between the mould over the greater trochanter and the [illegible] ectomy of the roof margin. [illegible]



FIG 15.—Ankylosing spondylitis with typical bilateral bony ankylosis of the sacro-iliac and hip joints.



FIG 16.—Appearance after bilateral hip joint reconstruction. Note the large acetabula.

osteotomy procedure is also valuable, of course, in cases of congenital dysplasia of the hip, when a new acetabulum is being reshaped at the anatomical level, or out of the shallow area which has been acting as a false acetabulum.

(*d*) *The proximal-shaft or inter-trochanteric arthroplasty* is one in which even the bone of the trochanter is unsuitable, and there shaping is done at the level of the lesser trochanter.

Effects of modified arthroplasty

These latter operations result in a loss of leg-length, but this may be of no importance in bilateral cases. Furthermore, in these cases of rheumatoid arthritis and ankylosing

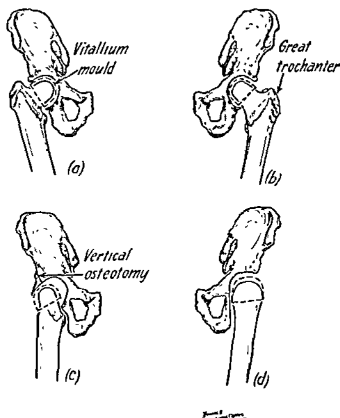


FIG. 17—Types of arthroplasty: (*a*) routine arthroplasty; (*b*) modified Whitman; (*c*) modified Colonna, (*d*) proximal-shaft or inter-trochanteric arthroplasty

spondylitis, in which fibrosis in the periarticular structures and muscle spasm are so marked, this wider degree of bone resection may be of value in restoring movement, as well as in preventing re-ankylosis. In all cases, the fixed deformity should be very largely overcome and pain considerably alleviated.

Comparison of the range of movement gained by mould arthroplasty in bilateral osteoarthritis of the hips and in rheumatoid arthritis is shown in Table IV.

The complications of arthroplasty which are encountered in rheumatoid arthritis are shown in Table V.

Pseudo-arthrosis of the hip in rheumatoid arthritis

In the rheumatoid group of cases, excision of the femoral head (Girdlestone, 1928) or excision of the femoral head and neck combined with a reverse-angled osteotomy (Batchelor, 1945) are operations which are widely used, and which certainly restore movement in joints which previously have been ankylosed, although they may show a slight tendency to instability. The periarticular fibrosis in these rheumatoid cases tends to counteract this instability, and so enables the patients to

TABLE IV
RESULTS OF MOULD ARTHROPLASTY

Type of arthritis	*No. of cases*	*No. of hips*	*Average age*	*Flexion*	*Abduction/ Adduction*	*Rotation*
Rheumatoid arthritis and ankylosing spondylitis	38	61	36 years	40°	20°	10°
Bilateral osteoarthritis	56	112	48 years	50°	35°	15°

TABLE V
COMPLICATIONS OF MOULD ARTHROPLASTY IN RHEUMATOID ARTHRITIS

Complication	*Early*	*Intermediate*	*Late*
Surgical shock	1 (death)	—	—
Superficial infection	2	—	—
Dislocation	3	1 (at revision)	—
Subtrochanteric fracture	1 (at operation)	—	1 (at manipulation)
Post-transfusion jaundice	2	—	—
Arthritic flare-up	—	1	—
Adhesions requiring manipulation	—	3	3

(38 cases, 61 hips).

proceed quickly without the use of either a temporary or permanent walking-caliper, which may be necessary in the osteoarthritic cases treated in this manner. Many surgeons are discouraged by the re-ankylosis in their attempts with vitallium mould or other kinds of arthroplasty of the hip in the rheumatoid group of cases, and therefore prefer an operation of the pseudo-arthrosis type. Even cases so treated may, however, tend to re-ankylosis or show stiffness and, of course, after pseudo-arthrosis the revision or secondary reconstruction of the joint is somewhat more difficult.

Rheumatoid arthritis of the knee joint

Bilateral involvement of the knees, with pain and swelling, is a common finding in rheumatoid arthritis, very frequently in conjunction with involvement of the hip and ankle joints, also. In such cases, arthrodesis, which renders the knees painless and stable, is not necessarily the ideal answer to the problem, although formal arthroplasty of the knee is as yet somewhat unsatisfactory.

Synovectomy and excision of semilunar cartilages

When the knee joint is grossly distended by synovial effusion and the synovial membrane is thickened and villous, a great deal can be achieved by excising the

synovial membrane as completely as possible, together with the semilunar cartilages. This operation is particularly indicated in those cases in which the joint is undergoing a periodical episodic derangement, with recurring joint effusion, gradual formation of fibrous adhesions and consequently loss of movement. The excision of the internal and external semilunar cartilages allows of an increase in the joint space, the more so if the hypertrophied synovial fringes and fatty pad are removed at the same time, and the subtotal synovectomy, together with a posterior capsulotomy, aids in regaining extension. When a persistent flexion deformity is present—and this is commonly associated with a subluxation of the joint—posterior capsulotomy is effective only if combined with the division of the posterior cruciate ligament, and in some cases even of the lateral ligaments. If synovectomy is performed too late in these cases, fusion of the knee will result, although this, of course, produces a painless and stable joint.

Capsulotomy

The safest way of performing a posterior capsulotomy is by subperiosteal dissection of the capsule off the posterior aspect of the femur, together with lengthening of the hamstring tendons, if necessary, and even drainage for 24 hours if haematoma formation is likely to be marked. So as to avoid over-stretching the tibial and peroneal nerves, which are kept under observation throughout this difficult dissection, only gradual extension of the knee joint should be carried out during the immediate post-operative phase.

Arthroplasty

Full arthroplasty of the knee, with removal of the articular cartilage on the lower end of the femur and the upper end of the tibia, and reshaping of the opposing bone



FIG 18.—Arthroplasty of the knee—unicondylar type incorporating a vitallium mould. The result was too unstable

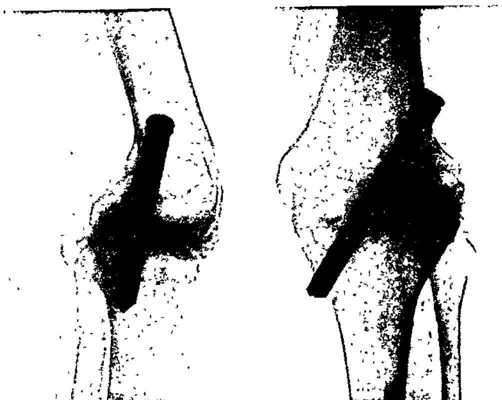


FIG. 19.—Rheumatoid arthritis of the knee treated by intra-articular arthrodesis and internal fixation by means of an obliquely placed three-flanged nail

surfaces, together with the interposition of fascia lata, nylon or even vitallium plates or moulds (Figs. 18 and 19), as yet has either resulted in an unstable knee or a knee which is stiff or undergoes progressive re-ankylosis. An additional problem in rheumatoid arthritis of the knee is the marked muscle wasting and fibrosis, particularly of the quadriceps group, which is an associated feature.

Excision of the patella

Excision of the patella alone, with the associated synovial membrane, is rarely of value in rheumatoid arthritis, although it may be so in osteoarthritis. If such an operation is performed, suturing of the lateral expansions, to avoid an extensor lag or instability, is important in the careful repair of the quadriceps apparatus.

Rheumatoid arthritis in the foot

In the forefoot, pain, with fixed claw-toe deformity of the metatarso-phalangeal joints, is common in rheumatoid arthritis, and this can be treated by excision of the metatarsal heads or of the bases of the proximal phalanges, or even by subperiosteal resection of the whole of the proximal phalanges. These operations allow restoration of the toe movements, and help in a more correct and more painless weight-bearing in the region of the transverse metatarsal arch. Valgus deformity of the great toe is best treated by an operation of the Kellar type, and any adventitious bursae which are present in the foot should be excised, together with the underlying abnormal bony overgrowths.

Pain in the interdigital spaces, caused by neuritis of the digital nerve, should be treated by excision of the corresponding neuro-vascular bundles.

When the toes are partially or completely dislocated on to the dorsum c metatarsal heads, amputation of these toes will give a much more satisfactor for weight-bearing purposes than would attempted plastic procedures.

In the rheumatoid patient, it is common to have to carry out many of these articular reconstructions for the relief of pain, and upper-limb procedures m required, for purposes of weight-bearing with crutches or sticks, prior to emba upon lower-limb reconstruction.

Rheumatoid arthritis of the jaws

Occasionally, arthroplasty of the temporo-mandibular joints is required init particularly in cases of ankylosing spondylitis. This enables easier feeding and a thetic intubation to take place, before an arduous and prolonged programme of reconstruction is carried out. The region of the temporo-mandibular joint is exp through a T-shaped incision in front of the tragus of the ear, and great care is requ to avoid injury to the facial nerve and superficial temporal vessels. The condyle o mandible is resected, with the use of small sharp osteotomes and bone-nibbling for and the second side is best treated some 1–3 weeks later.

After operation on the second side, the tongue may tend to slip back and b the entrance to the pharynx and larynx; consequently it may be necessary to ho forward by a stitch, temporarily, until muscle control is re-established.

Conclusions

Surgical resconstruction in the rheumatoid case may present a formidable prob to both patient and surgeon, but even the moderate functional results are well w while in relieving crippling deformity and in restoring a sense of some mental well as physical, well-being.

(*See also British Surgical Practice* Arthritis—Surgical Considerations, Vol. 1, page 371, S. Key

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BURNS–TREATMENT OF

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INTRODUCTION

In 1856 Professor James Syme wrote: "The treatment of burns has afforded a fruitful field for diversity of practice and opinion." Today a similar state of affairs exists, and current medical literature suggests the application of various pharmaceutical agents in the form of powders, pastes and ointments, or else treatment by immersion. There can be no doubt, therefore, that many problems still remain in regard to the care of the extensively burnt patient.

Attached to plastic surgery centres throughout Great Britain, burn units have been organized; these have helped in no small way to supply the necessary specialized surgical attention and nursing, since the care required by one severely burnt patient taxes the nursing facilities of any general surgical ward. Furthermore, because the injury is one of the skin, burnt patients should be supervised from the first by a plastic surgeon, preferably in his own specialized unit. It is essential that every burn unit, even if it is part of a plastic unit, should be closely associated with a general surgical teaching hospital.

CLASSIFICATION

Burns are classified by extent and by depth.

By extent

Various tables have been devised to help in the estimation of the surface extent of burns, the most accurate being those of Lund and Browder (1944). For emergency

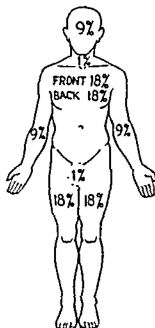


Fig. 20.—The "Rule of Nine" in burns.

work a modified Berkow table is suggested and is conveniently termed "the Rule of Nine" (Fig. 20). According to this, the head is assessed at 9 per cent of the total body-surface, and so is each upper extremity; the back of the trunk is assessed at 18 per cent, and so is the front of the trunk, also each lower extremity. Such figures can be remembered readily, and should prove most useful when the fluid requirement in the treatment of oligaemic shock is considered.

By depth

For the classification of burns by depth many descriptive values have been suggested. The most simple and efficient is the division into *superficial* and *deep* burns. Superficial burning implies involvement but not destruction of skin; "deep" implies that at some point of the burnt area there has been whole-thickness loss of skin; there is no indication as to whether subcutaneous fat, muscle or bone has been involved, but this information is considered unnecessary in a classification. What is necessary is an appraisal of the probable destruction of skin.

THE BURN PROBLEM

Writing on the problem of burns, Clarkson (1951) states: "In the primary phase the objects of treatment are, briefly, to preserve life by maintaining the circulation, and to prevent infection. Maintenance of the circulation involves: (1) restoring water, electrolyte and colloid balance by administering fluids: and (2) the possible control of the humoral factors in this mechanism by dialysis or by administering hormones, such as the adreno-corticotropic hormone (ACTH)."

It is generally recognized that following a burn metabolic upsets may occur in tissues at a distance from the site of the injury; they are characterized by changes in the distribution of the body fluids, shifts in osmotic equilibrium and concentration of electrolytes, and alterations in intermediary metabolism and hormonal equilibrium (Moore and his colleagues, 1950). Before a rational programme of replacement can be suggested, it is necessary to consider both the reason for and the nature of the loss from the circulation as a result of the injury

Loss of fluid

Cope (1951) aptly describes the burn wound as "a parasite on the surface of the body. The wound, like a leech, sucks water, protein and electrolytes from the plasma circulating through its depths, and it swells with oedema."

As a result of the injury the permeability of the capillary membrane is increased, and there passes into the burnt tissues a protein-rich filtrate. In addition, the normal reflex mechanism controlling blood flow is upset and the small arteries in the injured area open widely. The pressure and capillary blood flow are increased, and as a result, there is increased filtration of fluid into the burnt area. Oedema may increase until it is eventually limited by the very pressure of the tissue fluids and by the resistance of the covering skin. In deep burns, the elasticity of the skin has been destroyed, and the increase in the underlying pressure [illegible]

Oedema following a burn reaches its peak about 42 hours later, with reduction in filtration from the capillaries as a result of recovery of their lining membrane. There follows a period of fluid re-absorption and of steady diminution of oedema. This phase is most marked on the third day of the burn

Oedema formation can be influenced by cold and by posture. Cold reduces the

rate of capillary filtration by shifting the blood flow from the damaged capillaries to arterio-venous shunts. Posture is well recognized as influencing the blood flow. Undoubtedly procedures to produce correct posture in treating burns of the extremities have not been mentioned in first-aid instructions, and burn oedema might well be considerably reduced following the teaching of prompt early action.

Pressure dressings have been claimed to influence oedema formation. I am not in entire agreement and, with the added possible dangers from constriction following the application of such dressings, advise caution. The subject is referred to again below.

As to the nature of the fluid loss, the electrolyte pattern is that of plasma or extracellular fluid. Compared with tissue fluid, the latter has a greater concentration of plasma protein although less than that of plasma.

The initial phase following receipt of a burn is a slight rise in the protein concentration of the plasma, which creates an elevated colloid osmotic pressure. Fluid is absorbed from the unburnt tissues into the blood stream leading to a second phase with a dilute plasma. In the initial phase, re-absorption from the burn into the concentrated plasma is impossible owing to the damaged capillary membrane.

In the second phase in extensive untreated burns, fluid is drawn from the interstitial space into the blood stream with a rise of colloid protein in the interstitial fluid. Water is then drawn in turn from the cells into the extracellular space. Permanent damage may occur to renal cells if dehydration is not adequately treated.

Red cells are directly destroyed by heat in a burn which is sufficiently deep to coagulate the dermal capillaries. There is also a delayed haemoglobinaemia, which may be due either (1) to intravascular haemolysis of cells not completely destroyed but rendered more fragile by the same process (Shen, Ham and Fleming, 1943), or (2) to a specific haemolytic factor produced at the site of injury. This process of coagulation limits the continued exudation of fluid upon the surface; consequently, in an extensive deep burn the whole-blood loss may account for as much as 40 per cent of the total volume deficit (Evans and Biggar, 1945).

In the first 24 hours the main danger to the extensively burnt patient lies in the possibility of the development of tissue anoxia. Its prevention lies in adequate [illegible]

severe thermal burns as under.

A. Physical alterations in the circulating blood.

(1) Intravascular agglutination of red blood cells into "basic masses" of the burn sludge.

(2) Adherence of white cells to walls of small venules, reducing the rate of flow through *the small vessels.*

(3) Increased viscosity of plasma

(4) Sharp reduction in rate of flow of blood.

[illegible] by "thromboses"

[illegible]

[illegible] by diapedesis

[illegible]

B. Significance of the changes.

(1) Sludging may in itself lead or predispose to shock.

(2) The physical state of the blood may appear to be and be interpreted as a toxic effect.

The nature of the fluid loss may be summarized as follows.

(1) *Protein and water.*—Fluid with approximately half the protein concentration of plasma is lost into the interstitial spaces and from the surface. *This loss is greatest*

during the first 8 hours and continues at a slower rate until 36–42 hours after injury. The protein fraction may be partially coagulated *in situ*, but re-absorption of the extravasated fluid occurs fairly rapidly from this time onwards.

(2) *Electrolytes.*—The electrolyte pattern and concentration in the fluid lost from the site of injury are approximately the same as those of normal plasma (Cope and Moore, 1947).

(3) *Blood.*—In deep burns with the destruction of red cells, whole-blood transfusions are essential; they are also advisable in extensive superficial burns (over 25 per cent of surface area).

Replacement of fluid

From consideration of the above factors, the following relative amounts of replacement fluid are suggested.

Ideally, the mixture would be of colloid and electrolyte solutions, injected into the blood stream to replace the water, electrolytes and protein lost into the wound. Water should be given by the mouth to maintain normal renal function.

Plasma and saline solution should be given in equal proportions, so that the total protein and electrolyte content approximates to that of the fluid lost into the injured area (Cope and Moore, 1947). In practice, most or all of the electrolyte requirement can be given by the mouth.

Blood should be given in all cases of deep burns, and since, as stated above, nearly half of the volume deficit may be due to whole-blood loss, it is suggested that whole blood should replace up to half of the plasma-saline requirement in the first 8 hours. Haemoconcentration is not considered to be a contra-indication to the giving of blood and is, in fact, reduced by its administration.

In established shock from any cause, there is, in my opinion, a virtual loss of whole blood from the active circulation, which is due to its accumulation in stagnant dilated capillaries.

When a burnt patient is admitted with an already poor capillary circulation, as indicated by a slow return of colour on pressure, with or without cyanosis, whole blood is given at the calculated rate until the condition begins to improve, irrespective of the depth of the injury.

In the early stages of treatment of a deep burn, the administration of whole blood substantially delays and limits a characteristic anaemia, which may complicate the state of healing.

Table I shows the proportions of fluid replacement required in superficial and deep burns.

TABLE I

FLUID REPLACEMENT

Type of burn	*Plasma*	*Blood*	*Normal saline solution*
Superficial burn	2	0*	2
Deep burn (first 8 hours)	1	2	1

* Unless extensive.

In the cases treated there has been no evidence that the transfused cells have been haemolysed, nor have any other ill effects been observed.

In all cases, in addition to the replacement fluid given, the metabolic requirement must be met in full by giving the required amount of fluid for the age-group.

Biochemical investigation of alterations and deficiencies in the inorganic constituents

of the circulating blood has not been used as a guide to fluid and electrolyte requirements, because of the necessity for simplicity, and because a functioning kidney is the best regulator of blood chemistry; the aim should be to restore function to this natural regulating mechanism by prompt and adequate restoration of the circulating blood volume.

Moyer (1949) has shown that vomiting, headache, delirium and convulsions, ascribed to the general effects of or toxaemia from a burn, could arise from water intoxication, and could be avoided by the oral administration of sodium-bicarbonate—saline solution (3 grammes of sodium chloride and 1·5 grammes of sodium bicarbonate in 1 litre of distilled water) with restriction of water. Scudder (1940) postulated the toxicity of potassium in burn shock. Fox described the loss of potassium from the cells at the injured part, with replacement by sodium (Fox and Keston, 1945; Fox and Baer, 1947).

Estimation of fluid requirement

Although it is essential, clinical observation may be, except to the experienced, an insufficient guide to the quantity and rate of fluid administration required. A normal pulse-rate, blood pressure and blood concentration may give a false sense of security; alternatively, a severely shocked child may be given dangerously large volumes of fluid because of a slow initial response to transfusion.

In assessing the general condition of patients with burns—which can be done in most cases of burns, other than those sustained in atomic explosions—important criteria are (1) the patient's age, (2) the extent and depth of the burn, and (3) the time that has elapsed since its receipt. Some clinical indications of incipient oligaemic shock appear before there are any changes in blood pressure, haemoglobin or haematocrit. These are *pallor*, *thirst* and *restlessness*, and if any one of these is present fluid must be energetically administered. Assessment is based on the clinical picture, though it may be confirmed later by laboratory findings.

Serial haematocrit readings have been used to estimate the amount and rate of fluid loss (Morrison, 1947) but the method has several disadvantages. First, there is the practical difficulty of obtaining samples of blood from a small child. In shock from burns there is always a marked degree of venospasm, and it may be difficult to obtain blood even by femoral puncture. Secondly, before the initial estimation of plasma loss can be made, it is necessary to wait until haemoconcentration has occurred, and this is, in some cases, delayed until the clinical signs of shock are well established. Thirdly, in deep burns, because there is a loss of red cells as well as of plasma and electrolytes, the haematocrit reading may greatly under-estimate the total deficiency of circulating fluid volume.

An arbitrary method which provides at least a guide to the quantities required has obvious advantages. The formula which has been evolved (*see* Table II) is based on work previously published (Cope and Moore, 1947). It fulfils the following requirements:

(1) The quantity of fluid given is proportional to the extent of the area into which fluid is being lost,
(2) The rate of administration is parallel to the rate of local fluid loss;
(3) The amount given is proportional to the normal blood volume of the patient.

Although patients with extensive burns require large amounts of fluid, there is a limit to the distensibility of the interstitial space. It has been shown that fluid therapy should be restricted to a 48 hours' total corresponding to no more than a 50 per cent increase in extracellular-fluid volume, which is an amount not exceeding 10 per cent of body-weight.

TABLE II

FLUID REQUIREMENTS OF CHILDREN AND ADULTS

TOTAL FLUID (PER ML) REQUIRED IN FIRST 48 HOURS FOR EACH 1 PER CENT OF BODY-SURFACE BURNT

Route and type of fluid	*Age (Year)*															
	B-3 Mnth	*3–6 Mnth*	*6 9 Mnth*	*9–12 Mnth*	*1–2 Yr*	*2–3 Yr*	*3–4 Yr*	*4–5 Yr*	*5–6 Yr*	*6–7 Yr.*	*7–8 Yr*	*8–9 Yr*	*9–10 Yr*	*10–11 Yr*	*11–12 Yr*	*Adult*
Intravenous Saline solution	5	7	8	9	10	14	16	18	21	23	27	29	31	34	37	75
Plasma	5	7	8	9	10	14	16	18	21	23	27	29	31	34	37	75
By mouth Metabolic fluid requirement (glucose in water for each 24 hours)	160 ml per kg body-weight					100 ml per kg body-weight			80 ml per kg body-weight			50 ml per kg body-weight				

First 24 hours Give one-half of total in first 8 hours after burn and remainder in next 16 hours
Second 24 hours Give one-half of total for first 24 hours

When the first formula is applied, it is found that at any age the amount begins to exceed this limit when 30 per cent or more of body-area is involved. In such cases the second formula is used (Table III). The nature of the fluids given and their relative proportions are the same as before. In both cases, when whole blood is indicated, it is given at the outset

TABLE III

FLUID REPLACEMENT FORMULA

Fluid replacement formula for 48 hours after burns exceeding 30 per cent of body-surface		
Total intravenous fluid (ml) required in 48 hours	$= \frac{\text{Body-weight (kg)}}{10}$	
In first 24 hours	(First 8 hours: half of total) (Next 16 hours quarter of total)	
In second 24 hours	quarter of total	
By the mouth ·	*Aged 5- 8 yrs*	*Aged 8 yrs and upwards*
Metabolic fluid requirement (glucose in water) daily for first 48 hours	80 ml per kg body-weight	50 ml per kg. body-weight

Method of administration

From the point of view of fluid replacement, burns and scalds of less than 6 per cent of body-area can be disregarded Burns of 6–12 per cent, particularly in infants, should be regarded as potentially dangerous In such patients the calculated amount should be given by mouth in half-hourly or hourly doses, saline solution being substituted for plasma and the full metabolic requirement being added

It is suggested that, as a general rule, children with burns of 12 per cent or more and adults with burns of 18 per cent or more should be given fluid intravenously from the time of admission to hospital. Many do not show any clinical or haematological signs of shock at this time, but it is better to forestall their appearance by prompt treatment than to await their development.

When a child is drinking well, only the plasma (or blood and plasma) is given intravenously, the saline and metabolic requirement being given by the mouth. When there is vomiting, or when drinks are refused, the whole requirement must be given

intravenously and the metabolic requirement added as isotonic glucose solution. In infants it is always preferable to give sodium chloride solutions by the mouth, so that the child himself controls the rate of absorption. When this is impossible, a solution containing 0·18 per cent sodium chloride and 4·1 per cent glucose is given in preference to normal saline solution.

In all cases the first 8 hours' requirement is calculated from the time of injury, not from the time of beginning treatment.

Example.—A child aged 18 months is admitted 3 hours after injury, with burns involving 20 per cent of body surface.

According to Table II the requirement is 10 ml. of plasma and saline solution for each 1 per cent of area burnt.

First 24 hours' requirement = 20 × 10
= 200 ml. plasma.
+ 200 ml. saline solution.

Therefore, first 8 hours' requirement = 100 ml. plasma intravenously.
+ 100 ml. saline solution orally or intravenously.

Since the child was admitted 3 hours after the accident, this quantity must be given in the first 5 hours of treatment: i.e., 20 ml. of plasma and of saline solution per hour.

Metabolic requirement at 18 months = 2,000 ml (approximately) in 24 hours.
= 90 ml. per hour of non-electrolyte fluid orally.

Charts as designed by Lund and Browder (1944) are used for estimating surface area. (Figs. 21 and 22.)

TABLE IV

TABLE OF AVERAGE VALUES IN CHILDHOOD*

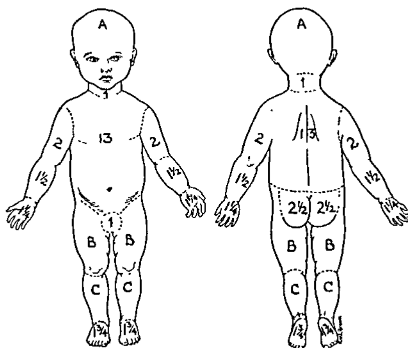
Age	*Weight (kg)*	*Height (cm.)*	*Hb. % (Sahli)*	*PCV.*	*Total PV.*	*Total BV.*
Birth	3	40	95	55	180	400
0– 3 months	5	62	65	40	200	350
4– 6 months	7	68	70	40	300	500
7– 9 months	9	72	70	40	330	550
10–12 months	10	76	70	40	360	600
1– 2 years	13	88	70	40	500	850
2– 3 years	15	96	75	43	550	1,000
3– 4 years	17	103	80	43	650	1,150
4– 5 years	18	104	80	43	750	1,350
5– 6 years	20	111	85	43	850	1,500
6– 7 years	22	117	85	43	1,000	1,700
7– 8 years	24	123	85	43	1,100	1,900
8– 9 years	26	128	85	43	1,200	2,100
9–10 years	29	133	90	43	1,300	2,300
10–11 years	32	138	90	44	1,400	2,500
11–12 years	35	143	90	44	1,500	2,700

* Modified from Russell (1949)

PCV = Packed cell volume. PV = Plasma volume. *BV = Blood volume.*

[illegible] in Richmond (Virginia) confirms the figures elaborated from the fluid-requ [illegible]
as 1 [illegible]
during the first 24 hours. Half this amount is given in the second [illegible] burn surface is greater than *25 per cent*, Evans advocates whole blood and plasma in equal quantities. He suggests the same formula for fluid and electrolyte requirements: 1 millilitre of electrolyte solution (*0 9 per cent sodium chloride*) *per kilogram for each* 1 per cent of body surface burnt, during the first 24 hours. Half this amount is given

NAME . . . . AGE . . NUMBER . . . . .
BURN RECORD AGES—BIRTH-7½ DATE OF OBSERVATION . . . .



RELATIVE PERCENTAGES OF AREAS AFFECTED BY GROWTH

AREA	AGE 0	1	5
A = ½ OF HEAD	9½	8½	6½
B = ½ OF ONE THIGH	2¾	3¼	4
C = ½ OF ONE LEG	2½	2½	2¾

PERCENTAGE BURN BY AREAS

PROBABLE DEEP BURN HEAD . . NECK . . BODY . . . UP ARM . . . . . .
FOREARM . . HANDS . . GENITALS . . . . . .
BUTTOCKS . . . THIGHS . . LEGS . . FEET . . .

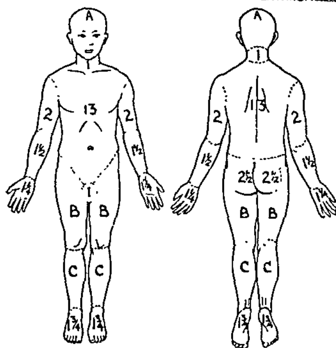
TOTAL BURN HEAD . . NECK . . BODY . . UP ARM . . . . . .
FOREARM . . HANDS . . . . GENITALS . . . . . .
BUTTOCKS . . THIGHS . . . . LEGS . . . FEET . . . .

SUM OF ALL AREAS PROBABLY 3rd° . . . . TOTAL BURN . . . .

FIG 21.—Estimation of surface area in infants and young children. (*By courtesy of the British Journal of Plastic Surgery.*)

NAME... ....AGE... NUMBER ____

BURN RECORD AGES 7½ TO ADULT DATE OF OBSERVATION________



RELATIVE PERCENTAGES OF AREAS AFFECTED BY GROWTH

AREA	AGE 10	15	ADULT
A ½ OF HEAD	5½	4½	3½
B ½ OF ONE THIGH	4¼	4½	4¾
C ½ OF ONE LEG	3	3¼	3½

PERCENTAGE BURN BY AREAS

PROBABLE DEEP BURN HEAD __ NECK __ BODY ____ UP ARM ____ FOREARM __ HANDS __ GENITALS ____ BUTTOCKS ____ THIGHS ____ LEGS ____ FEET ____

TOTAL BURN HEAD __ NECK __ BODY ____ UP ARM ____ FOREARM __ HANDS __ GENITALS ____ BUTTOCKS ____ THIGHS ____ LEGS ____ FEET ____

SUM OF ALL AREAS PROBABLY 3rd ______ TOTAL BURN ________

Fig. 22 —Estimation of surface area in older children and adults.
(By courtesy of the British Journal of Plastic Surgery.)

in the second 24 hours. To all burnt adult patients he gives 2,000 millilitres of 5 per cent dextrose in water daily to maintain a urine output of at least 20 millilitres per hour. To patients with burns of the face and buttocks, an additional amount of fluid and electrolyte is given, because oedema formation in these areas is greater than elsewhere. Evans limits the plasma intake in the first day to 3,500 or 4,000 millilitres with the same amount of salt solution Half the amount is given on the second day.

The chief complicating factors in fluid therapy for burnt patients are, if they are under-treated, the possible development of renal damage and, if over-treated, the possible development of pulmonary oedema In cases with pulmonary damage intravenous fluid must be administered with considerable caution An hourly urinary output of about 25 millilitres should be maintained during the first two days.

Intravenous therapy must be always carefully controlled and, between 48 and 72 hours from the accident, when the local capillary permeability has returned to normal and diuresis has started, the amount of fluid administered should be restricted.

Plasma substitutes

As is indicated above, the colloid fluids of choice are blood and plasma. With the possible necessity of treating mass casualties, the importance of plasma substitutes becomes a major issue. The substitutes that have been investigated are gelatin, globin, plasmosan, dextran and gum. Evans (1951) reports favourably on gelatin, but believes that the limitation of supplies of material in the correct physical state disqualifies it from consideration. Globin is derived from the red cells of stored blood and its value has been described by Strumia (1950) Dextran, unlike the proteins of gelatin and globin, is a polysaccharide, and has been proved effective as a plasma substitute by Bull (1951), Rosenquist and Thorsen (1951), and by Wilkinson (1951). Disadvantages advanced are that dextran dilutes the plasma protein, affects the erythrocyte sedimentation rate, leads to occasional reactions and, by producing rouleaux formation, makes blood grouping difficult, furthermore, its eventual fate in the body is incompletely understood.

Bayliss (1917) showed that the addition of 6 per cent of gum arabic to physiological saline solution extended the period during which saline solutions restored the volume of circulating fluid, by retarding the rate of excretion of fluid. Criticisms, probably unjustifiable, of the use of gum have led to its disrepute; inconsistencies of composition or impurities have affected the liver, and gum arabic is also thought to coat the red cells and so prevent normal physiological fluid exchanges. However, some reliable workers have used gum enthusiastically and successfully for many years.

Hecht and Weese (1943) used a colloid [illegible]
to retard the excretion of saline solutions by [illegible]
was used by the Germans in World War [illegible]
paration of P.V P. has now been improved, and an effective isotonic solution, termed plasmosan, has been elaborated. A preliminary report by Thrower and Campbell (1951) looks promising.

Humoral factors

The shock phase in burns is characterized by findings which constitute the alarm reaction: (1) hypothermia, (2) hypotension, (3) haemoconcentration, (4) increased capillary permeability, (5) increased tissue katabolism and (6) depression of the nervous system. It is possible to modify the character of this response to stress.

As a preliminary to the understanding of the problem, Thorn (1951) describes the underlying factors in three humoral "systems". System "A" includes the direct local and general effects of the tissue breakdown products at the site of the burn; system "B" is the hypothalamic—pituitary—adrenal-cortical and adrenal-medullary system

and the integration of the central nervous system; and system "C" includes the effects on the liver and kidney metabolism.

To elaborate, in system "A" the burnt tissues are the source of many toxic substances, which are carried to other organs and tissues with deleterious effects. While early fluid replacement undoubtedly counters the production of oligaemic shock, it must, by improving blood circulation, increase the danger from circulating noxious substances.

System "B" includes the response of the hypothalamus and of the pituitary gland and adrenal cortex, and must include the adrenal medulla and the manifestations in the nervous system. The release of hormones initiates another series of changes, modified by the amount and type of adrenocortical hormone secreted in response to the stress. The adrenocortical hormones have been shown by Thorn (1951) to exert an important regulating effect on the following mechanisms.

Endocrine-regulating effects

(1) Suppression of production of anterior pituitary hormone (ACTH) and, to a lesser extent, of thyrotropic and follicular-stimulating hormones.
(2) Posterior pituitary antagonism.
(3) Anti-insulin effect.

Specific metabolic effects

(1) Electrolyte regulation: sodium, chlorine, potassium
(2) Regulation of carbohydrate, fat and protein utilization
(3) Androgenic activity.

Neuromuscular effects

(1) Increase in the frequency of the electroencephalogram.
(2) Changes in the electrocardiogram.
(3) Central excitatory action.

Following a burn there is a marked increase in the output of adrenocortical hormone. In the majority of cases of moderate burns the response of the adrenal cortex is adequate; but it would appear in severe burns that there may exist a relative or absolute deficiency of adrenal steroids. This may be brought about (a) by inadequate stimulation of the hypothalamic pituitary system; (b) by injured pituitary and adrenal glands as the result of haemorrhage and parenchymatous changes in the gland, secondary to the absorption of toxic products from the burn area; (c) by a tremendous increase in hormonal requirement because of widespread tissue injury.

In many severely burnt patients there is probably a considerable inadequacy of adrenocortical hormone response. In these circumstances the administration of supplementary hormone would appear to be justified, for it would be an attempt to restore a normal adrenal-steroid level.

Adrenocortical hormone secretion or action can be followed by (a) changes in circulating eosinophil level, (b) urinary 17-ketosteroid excretion, and (c) urinary 11-oxysteroid determination.

System "C" is the renal–hepatic mechanism. The kidney and liver are jointly responsible for maintaining blood pressure. It is well known that the kidney secretes into the blood stream pressor substances, which tend to maintain normal or elevated blood pressure, while from recent work it seems that the liver secretes depressor substances into the blood stream. The blood pressure at any given moment reflects the balance of the effects of these two types of substance. A new approach has been indicated by the use of the artificial kidney in its capacity to dialyse blood. It would appear that, in the course of dialysing the blood, some component is removed, which then permits the blood vessel to respond to ordinary pressor stimuli.

In summary: (1) a patient with a deep burn normally demonstrates an ACTH

and adrenocortical stimulation, which are beneficial; (2) the extensive tissue damage leads to great utilization and destruction of steroid hormone; (3) studies of activation must always be completed and analysed before the administration of hormones; (4) it must be remembered that both ACTH and cortisone inhibit the patient's other endocrine responses; (5) in the late scarring phase in burns, cortisone might be administered to increase the mobility of the affected parts.

In respect of dosage, it is well to remember that, during the first 4 days, stimulation with ACTH is probably maximal, and that the need is for adrenal steroids. Because up to 500 milligrams per day can be inactivated, large doses of cortisone may be required. After 2–4 days of cortisone, it is advisable to change to ACTH and continue until the tenth day (Moore, 1951).

It is important to remember that sodium diuresis is delayed, and that the sodium intake must be drastically reduced, while the natural barriers to infection are being interfered with. The administration of ACTH blocks the body's reaction to injury. Capillary permeability is reduced and there is reduction of pyrexia, tachycardia and malaise. In later stages it is possible that ACTH may prevent the formation of scar tissue and, in addition, that its lymphocytolytic action may modify antigen–antibody reactions and prolong the survival time of homografts.

Supportive measures

In addition to fluid replacement, in the general care of the burnt patient the following supportive measures are adopted.

(1) *Sedation.*—Rest lowers the oxygen requirement of the tissues and, since oligaemic shock causes death from tissue anoxia, adequate sedation is a logical procedure. This has been confirmed in practice, and ill-effects on the respiratory or central nervous systems have not been observed. After extensive trial of other drugs, particularly chloral hydrate and Seconal (sodium-propyl-methyl-carbinyl-allyl-barbiturate), morphine has been found to be the most satisfactory. Smaller doses are required than are usual for the age and weight, and the drug should be given slowly, through the intravenous cannula, in order to avoid the danger of accumulation and sudden absorption of successive doses from the subcutaneous tissues.

(2) *Oxygen.*—Administration at the rate of 3 litres per minute, by means of intranasal catheters, has been found the most satisfactory method. A tent, however carefully used, tends to cause overheating, and it prevents ready access to and observation of the patient. In severely shocked children aeration of the lungs is poor, and it is possible that there may be some degree of central, in addition to peripheral, anoxia. The clinical impression derived from many cases is that the use of oxygen is beneficial, whether or not there is any evidence of direct thermal injury to the respiratory tract.

(3) *Posture.*—Postural treatment can be a two-edged weapon. The head-down

On the other hand, burn trauma has been stated to upset the normal restraining reflex mechanism controlling blood flow, so that the arterial blood flow to the burnt area is wide open, thus the pressure and flow of blood within the capillaries is increased and also the filtration of fluid into the injured tissues. To reduce the pressure and blood flow, appropriate posture (such as elevation of the burnt area) should be adopted early. It seems strange that this procedure has so seldom been stressed as a *first-aid measure* for burns of the extremities. Undoubtedly oedema in many cases would have been less severe had this been so.

(4) *Avoidance of heat.*—The application of external heat in any form is to be strictly avoided.

(5) *Treatment of hyperpyrexia.*—This is a not uncommon complication which

occurs usually during the first 72 hours after injury; very high temperatures may be reached and, especially in the case of a child, unless immediate and vigorous steps are taken the patient may die. Cold sponging of the uninjured skin, combined with fanning and exposure near an open window, usually reduces the temperature quickly if applied courageously. The possibility of a transfusion incompatability should be considered in relation to all patients who are receiving fluid intravenously, although this has never been proved to be a cause of hyperpyrexia in any of the cases treated by me.

Assessment of progress

The following observations are recorded at half-hourly or hourly intervals, according to the severity of the condition.

(1) *Capillary circulation*.—The state of the capillary circulation is judged by the colour of the skin (for example, pallor cyanosis, colour return on pressure), and by the skin temperature (including coldness of the nose and extremities). Lessening of pallor and increasing warmth are welcome signs.

(2) *Mental state and behaviour*.—A spasmodic restlessness occurs early in the development of oligaemic shock and is in itself an indication for fluid administration; it is usually accompanied by thirst. If the condition is more advanced, the child is quiet, alert and co-operative, thirst is intense and vomiting is common. Decreasing restlessness and thirst indicate satisfactory fluid replacement.

(3) *Pulse*.—Changes in rate are of little diagnostic or prognostic significance, but a fall in pulse pressure usually precedes a fall in mean blood pressure.

(4) *Temperature*.—The rectal temperature is recorded half-hourly, so that hyperpyrexia can be treated immediately.

(5) *Respiration*.—In addition to watching for signs of injury to the bronchial tract, the rate and character of respiration are observed, and frequent auscultation is carried out to detect any development of basal oedema due to over-hydration.

(6) *Blood pressure*.—A fall in blood pressure is a late sign which should be avoided, not awaited. A small percentage of cases show an elevation of pressure, which may be maintained for hours or even days.

(7) *Haemoglobin*.—The haemoglobin level throughout an age-group is more variable than the haematocrit reading, so that the initial level may be of little significance unless it is grossly elevated. However, in an individual case, changes in level follow closely any changes in the haematocrit reading, and are of great value in assessing progress.

(8) *Intravascular haemolysis*.—When possible, the plasma is examined for signs of haemolysis.

(9) *Urinary excretion*.—This is the most valuable single guide to progress and to

TABLE V

URINARY EXCRETION

Age (years)	*Volume excreted (ml)*	
	In 24 hours	*Per hour (approx.)*
4–7	575–650	24–28
7–10	650–725	28–30
10–12	725–800	30–33
Adult	1,500	60

the efficacy of treatment. (*See* Table V.) It is measured by means of an indwelling catheter, released at hourly intervals. The specimens so obtained are examined for albumin, casts, red blood cells and haemoglobin.

(10) *Fluid intake*.—Oral and intravenous intakes are recorded at hourly intervals on the same chart.

Nutritional care

Most studies of metabolic changes have been directed to the problem of nitrogen metabolism and have shown clearly in extensive burns a significant nitrogen depletion The degree of loss depends on (1) depth of burn, (2) extent of burn and (3) the presence of infection In addition to loss from the burnt surface, there is also an increased urinary excretion of non-protein nitrogen, starting about the third day, reaching its peak in the first or second week and persisting for 3–4 weeks.

As is indicated above, there are disturbances in water and electrolyte metabolism. The sodium and chloride balances are initially positive, but with the absorption of oedema the balances become negative. For the first 2 or 3 days there is a negative potassium balance.

Carbohydrate metabolism is frequently upset following burns.

Liver function is likewise upset

The food provided to burnt patients must contain adequate amounts of protein, carbohydrates, fat, minerals, water and accessory food substances Nutritional requirements should, if possible, be supplied by the mouth. If this is not possible, then the necessary food should be given by gastric or jejunal tube. Feeds should be started early, but they are not often tolerated before the third day.

If a gastric tube is employed, feeds can be administered through a drip apparatus. The mixture contains per litre the following proportions. 150 grammes of protein, 265 grammes of carbohydrate, and 90 grammes of fat. From time to time there are patients who, for one reason or another, cannot obtain an adequate caloric intake, and recent work has indicated the importance of administering fat in emulsion form. Points in its favour are as follows. (1) it aids the utilization of other nutrients; (2) it provides abundant calories in a small volume; (3) given as an emulsion, intravenously, fat is not lost in the urine or faeces; (4) given intravenously, it is not irritant to the veins, (5) fat emulsions serve as vehicles for the administration of fat-soluble drugs

Certain precautions are necessary, however the emulsion particles should be less than 0 5 micron in size and the emulsion should be free of pyrogens The fat generally used is coconut oil.

When given by the mouth fat in emulsion, consisting of small particles, is palatable and does not taste like fat, and the caloric intake can be stepped up.

Local care

Prevention of infection

The prevention of infection is chiefly a matter of local care, and this becomes one of the main preoccupations of the surgeon.

The growth of micro-organisms is favoured by the presence of moisture, warmth and darkness, the invasiveness of bacteria from the surface of the body is encouraged by moist or warm dressings, by the presence of damaged or dead tissue, by movement of the part, and by lax nursing care. The treatment of areas of surface trauma should therefore be based on the following principles: (1) control of infection with antibiotics, (2) making the burnt area unfavourable for the growth and multiplication of organisms, and (3) reducing the invasiveness of surface organisms, (a) by avoiding moist applications and any but bland antiseptics, (b) by keeping the part cool and

immobile, and (c) by strict nursing care. Whenever it is possible, oedema should be limited by elevating the affected part.

My personal experience in the culture of epithelium *in vitro* has indicated the importance of cooling. I decided, therefore, to elaborate a method which would fulfil the principles enumerated.

The exposure method and related absorptive dressings

Exposure of a burn to the air is by no means a new procedure. Unfortunately, however, shortly after its introduction 70 years ago, the method was combined with exposure to dry heat, and eventually it fell into disrepute. In its present-day form its essential features are (1) the administration of penicillin systemically, (2) full exposure and early elevation of the affected part with as much immobilization as is practicable, and (3) abstention from all local irritants and any form of local heating.

Few surgeons have followed the day-to-day progress and appearance of superficial and deep burns treated by "dry" methods. The clinical picture is at times so unfamiliar as to be almost frightening, yet similar changes must take place regularly under "pressure dressings". The early formation of a scab is of paramount importance, for it protects the wound against the entrance of pathogenic organisms, provides a framework or scaffold for young epithelium and, in deep burns, presents a barrier to the loss of protein, salt and red blood cells. Thus nothing must be done either to delay its formation or to disturb its integrity. The crust separates from superficial burns within 3 weeks, leaving a healed surface; with deep burns, after the same interval, sloughs must be excised and skin-grafts applied to areas of skin loss.

For some years I employed the so-called pressure-dressing technique, so favourably referred to by Syme in 1856, and I have described the details of the method (Wallace, 1948). If pressure dressings limit the swelling of tissues, encourage the return of venous blood, limit both venous and lymphatic stasis and reduce infection, then they should play a part in the treatment of burns. Recent experimental work on the pressure bandage, by Rhinelander, Langohr and Cope (1949), indicated that the loss of plasma was retarded but not necessarily reduced, that venous pressure, arterial–venous oxygen difference and arterial blood flow were not altered, and that the tissue pressure under the bandage approached, but never reached, the mean arterial pressure. It would appear, therefore, that there is no definite evidence that pressure dressings are beneficial in the treatment of burns. The chief benefits are derived probably from the posture adopted, from the immobilization and from the limitation of infection. I believe that the limitation of infection results not from protection and cover, but from encouragement of the production of a dry surface. Should dressings become moist, organisms can pass readily inwards from the covering bandages. Both from the point of view of prevention of absorption and from that of the prevention of the entrance of infection, all covering dressings must be dry.

I believe that the pressure, when adopted, should be applied to the overlying wool and not to the tissues; if both are compressed, in cases showing excessive oedema such dressings may be dangerous, even in the hands of an experienced surgeon. Pressure applied to cotton-wool by a bandage gradually decreases, and the expanding cotton-wool becomes increasingly absorptive. It would therefore be more accurate to call these "absorptive dressings". At the first change of dressing, after 12–14 days, it is noticeable that, if the absorptive dressings are dry, the superficial burns will have healed; the sloughs of deep burns can be excised and skin-grafts applied.

Expo [illegible] pressure-dressing a "close [illegible] 's in a name? [illegible] *l only* to skin as an effective barrier to surface infection and is much more [illegible] than any artificial cover. The exposure method is therefore essentially "closed".

The absorptive (or pressure) dressing is closed only so long as it remains dry. Should it become and remain moist for even a short time, infection can pass in from the covering bandages. It, therefore, can be an "open" treatment.

Some excellent results in burns of the face exposed to the air convinced me of the importance of a dry surface. A dry surface is certainly effective in controlling infection in areas denuded of skin by trauma, and I feel sure that a dry crust plays a similar part in the treatment of burns. For 3 years, therefore, every effort has been made to get the burnt surfaces dry as soon as possible and to keep them dry. Apart from direct excision in localized areas of obvious skin loss, the only local treatments which I have used have been (1) absorptive dressings over a bland surface application and (2) exposure. The principles, in summary, of both these methods of treatment are as follows: (a) to make the burnt surface unfavourable for the growth of bacteria by producing and maintaining a dry surface and, if possible, exposing the surface to light and keeping it cool; (b) to apply an antiseptic which is not toxic to tissue cells; (c) to rest the affected part, (d) to limit oedema by elevation (e) to simplify nursing care.

The benefits derived from absorptive dressings and drying by exposure are compared in Table VI.

TABLE VI

COMPARATIVE FEATURES OF ABSORPTIVE DRESSINGS AND DRYING BY EXPOSURE

Feature	*Absorptive dressings*	*Drying by exposure*
Dry surface	+ (if really absorptive)	+ +
Exposure to daylight	—	+
Cooling of surface	—	+
Immobilization	+ +	+
Limitation of oedema	+	–
Nursing care	+	–

When absorptive dressings are used, evaporation should be encouraged and nothing should be applied which might make the burnt surface sodden.

The two forms of local care, far from being distinct, as the terms "open" and "closed" sometimes applied to them would suggest, are in fact closely related and [illegible]

[illegible] are useful for first-aid in the field, at the base hospital the dressings will be removed and the burn exposed or a further absorptive dressing applied.

In my burns unit, cleansing is often done under inhalation anaesthesia (cyclopropane), which can be considered as a form of sedation. The burnt area is cleansed with 1 per cent cetrimide or with isotonic saline solution. Blisters are snipped and raised epidermis is removed. The burnt surface is then gently dried with gauze and dusted with a powder consisting of lactose with the addition of 10,000 international units of calcium penicillin per gramme. I have the impression that, provided the systemic administration of penicillin is carried out regularly, the local application of penicillin might be omitted. If it is used, the powder is insufflated over the burnt surface every 4 hours until the surface is dry (usually for 48 hours). Pain has not been a prominent feature.

All manner of organisms fall on the burn, but they do no harm. *Pseudomonas pyocyanea* and *Proteus vulgaris* have been grown on culture plates placed beside burnt surfaces, but they have never infected the burns.

One question is frequently asked: does the exposure method of treatment increase or decrease the necessity for grafting? What is seldom appreciated is that the necessity for grafting is determined at the time of injury. If the full thickness of skin has been destroyed, nothing will restore its viability, and skin must be applied if deformity is to be avoided. By the limitation of infection, however, and by the strict avoidance of anything which will cause further injury to damaged tissues, the exposure method reduces the chance that a burn, which initially destroyed only part of the dermis, will be converted into one involving full-thickness skin loss. This finding has been confirmed by Blocker (1951).

Exposure of burns is combined, as a rule, with antibiotic therapy. Penicillin should be given systemically as soon as possible, either intramuscularly or in the intravenous fluid, in a dosage of 0·5 mega-unit in each 24 hours. Except in burns of the neck and burns of considerable extent, systemic administration of penicillin is discontinued from the sixth day.

Areas of the body in relation to treatment

The principles of exposure with immobilization are relatively easy to fulfil in certain areas of the body, and more difficult to apply in others. The confidence of the sister in charge of the nursing should be the deciding factor in the final decision of the difficult case.

Regions characteristically straightforward in respect of treatment are the face, upper arm and forearm, front of trunk and abdomen, genitalia, buttocks and thighs, and back; the more troublesome are neck burns, circumferential burns of the trunk, and burns of the legs, hands and fingers. Deep burns present additional problems and are considered separately.

Face.—The patient is nursed on his back. The eyelids, the vestibules of the nose, the lips, and the external auditory canals are lightly smeared with soft paraffin. Any discharge from the eyes, nose or ears is gently removed. Within about 4 hours the eyelids close because of oedema, rendering the patient relatively helpless until the fluid is re-absorbed on the third and fourth days. In deep burns of the eyelids it is preferable to perform an immediate tarsorrhaphy.

Upper arm.—Elevation and relative immobilization can be achieved by suspension, by means of adhesive strips applied to the forearm.

Forearm.—The weight of the upper extremity can be dispersed by taking some support through suspension from the upper arm, and by using tapes from a stockinette mitten applied to the hand.

Trunk, abdomen and back.—(One aspect only.) There is little trouble in these regions and patients can be allowed to get up from the fourth day.

Genitalia.—Oedema of the prepuce is apt to be extreme, and from its orifice pus may discharge. This does not, however, appear to interfere in any way with healing, which, compared with that obtained by other methods of treatment, has been considered rapid.

Buttocks, perineum and upper thighs.—In children, the lower extremities are raised by skin traction from gallows splints until the buttocks are off the bed. Adults with burns of the buttocks and perineum are nursed prone, with the legs slightly abducted.

As is mentioned above, in certain areas the principles of exposure and immobilization are not so easy to apply.

Neck.—An entirely satisfactory method has not yet been evolved. Extension of the neck, sufficient to open out all the creases, is impossible without causing discomfort

and difficulty in swallowing; moderate extension is, therefore, advised. The movements of swallowing disturb crust formation and lead to cracks. In spite of the difficulties, burns of the neck, if certain precautions are observed, do remarkably well. The area is dried carefully after feeding and fresh penicillin powder applied to cracks as they form. Systemic administration of penicillin is continued as long as the neck continues to be moist or cracks tend to occur in the crust.

Circumferential burns of the trunk and legs.—The use of a sectional nursing frame has proved valuable in the nursing of extensive burns. Some burns of the trunk and legs, because of their distribution and the weight of the patient, cannot be exposed adequately. Rather than make a poor attempt at exposure and immobilization, it is better to turn the patient frequently so that the parts are exposed to the atmosphere in turn and allowed to dry gradually. The bed is covered with a sterile absorptive pad, which is changed frequently, so that the weight-bearing parts are never allowed to become sodden. The drying process may take 5 days. The patient should then be allowed to get up for a short time each day.

Hands and fingers.—In treating children, burnt hands with circumferential involvement of the fingers have been exposed by inserting silk threads through the nail, and suspending them from a wooden spreader with the hand in the position of function The weight of the arm is taken by supporting the elbow on a pillow. Fingers, with involvement of the palmar aspect only, can be extended on a flat type of splint. In children, immobilization of the fingers in extension up to the time of grafting is not followed by stiffness. In adults, the position in nursing care depends on the parts involved. With circumferential burns of the fingers, good results follow the application of an absorptive dressing for 48 hours, followed by exposure of the burnt surface, together with any dressing that has become incorporated in the dry crust.

The deep burn

The problem of the deep burn is common to all methods of local treatment. Once drying has been achieved and infection thereby controlled, the treatment of a deep burn becomes the surgical problem of skin replacement. In all burns, superficial and deep, the cover sequence should be from the crust, leading within 3 weeks without any intervening raw surface, to skin cover. This is accomplished in superficial burns by natural healing, but in deep burns it requires the intervention of the surgeon. When to intervene depends on many factors, of which the first is the consideration of the patient as a whole rather than consideration of the injury. There is no doubt that the maxim of skin coverage at the earliest possible moment is the ideal aim, but few children and few elderly patients will tolerate extensive excision and grafting at less than 2–3 weeks after a severe injury, except under expert hands. Should the general condition of the patient be good, the burn deep and the surgeon experienced in grafting, excision and cover can, with advantage, be carried out in 7–10 days from the time of injury. In deep burns—say with both lower extremities completely involved—excision and grafting might have to be performed at the tenth day, to allow the second leg to be dealt with by the twenty-first day Teamwork is essential.

A further problem is the difficulty of diagnosing the depth of injury in the early stages. If excision is carried out earlier than the eighteenth day, then, undoubtedly, one runs the risk of excising areas where the dermis is only partially destroyed, and which would have healed spontaneously had a more conservative policy been followed.

On culture, the semi-fluid layer, which forms under the crust covering burns with destruction of skin but not of fat, is found from time to time to be contaminated by the coliform group of organisms, but these are judged to be of an attenuated strain and of low virulence, because of the absence of fever, the relatively healthy state of the granulating surface when this milky material is gently wiped away, and the success of immediate grafting.

All manner of organisms fall on the burn, but they do no harm. *Pseudomonas pyocyanea* and *Proteus vulgaris* have been grown on culture plates placed beside burnt surfaces, but they have never infected the burns.

One question is frequently asked: does the exposure method of treatment increase or decrease the necessity for grafting? What is seldom appreciated is that the necessity for grafting is determined at the time of injury. If the full thickness of skin has been destroyed, nothing will restore its viability, and skin must be applied if deformity is to be avoided. By the limitation of infection, however, and by the strict avoidance of anything which will cause further injury to damaged tissues, the exposure method reduces the chance that a burn, which initially destroyed only part of the dermis, will be converted into one involving full-thickness skin loss. This finding has been confirmed by Blocker (1951).

Exposure of burns is combined, as a rule, with antibiotic therapy. Penicillin should be given systemically as soon as possible, either intramuscularly or in the intravenous fluid, in a dosage of 0·5 mega-unit in each 24 hours Except in burns of the neck and burns of considerable extent, systemic administration of penicillin is discontinued from the sixth day.

Areas of the body in relation to treatment

The principles of exposure with immobilization are relatively easy to fulfil in certain areas of the body, and more difficult to apply in others. The confidence of the sister in charge of the nursing should be the deciding factor in the final decision of the difficult case.

Regions characteristically straightforward in respect of treatment are the face, upper arm and forearm, front of trunk and abdomen, genitalia, buttocks and thighs, and back; the more troublesome are neck burns, circumferential burns of the trunk, and burns of the legs, hands and fingers. Deep burns present additional problems and are considered separately.

Face.—The patient is nursed on his back. The eyelids, the vestibules of the nose, the lips, and the external auditory canals are lightly smeared with soft paraffin. Any discharge from the eyes, nose or ears is gently removed. Within about 4 hours the eyelids close because of oedema, rendering the patient relatively helpless until the fluid is re-absorbed on the third and fourth days. In deep burns of the eyelids it is preferable to perform an immediate tarsorrhaphy.

Upper arm.—Elevation and relative immobilization can be achieved by suspension, by means of adhesive strips applied to the forearm.

Forearm.—The weight of the upper extremity can be dispersed by taking some support through suspension from the upper arm, and by using tapes from a stockinette mitten applied to the hand.

Trunk, abdomen and back —(One aspect only.) There is little trouble in these regions and patients can be allowed to get up from the fourth day.

Genitalia.—Oedema of the prepuce is apt to be extreme, and from its orifice pus may discharge. This does not, however, appear to interfere in any way with healing, which, compared with that obtained by other methods of treatment, has been considered rapid.

Buttocks, perineum and upper thighs.—In children, the lower extremities are raised by skin traction from gallows splints until the buttocks are off the bed. Adults with burns of the buttocks and perineum are nursed prone, with the legs slightly abducted.

As is mentioned above, in certain areas the principles of exposure and immobilization are not so easy to apply.

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and difficulty in swallowing; moderate extension is, therefore, advised. The movements of swallowing disturb crust formation and lead to cracks. In spite of the difficulties, burns of the neck, if certain precautions are observed, do remarkably well. The area is dried carefully after feeding and fresh penicillin powder applied to cracks as they form. Systemic administration of penicillin is continued as long as the neck continues to be moist or cracks tend to occur in the crust.

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The receptiveness of a raw surface decreases from the time of injury and, in our experience, it is infinitely preferable to graft as early as possible, even in the presence of bacteriological evidence of infection, than to spend valuable weeks in trying to sterilize the surface.

The area of crusting which is removed, when grafting is adjudged advisable, depends on the total surface area of the crust and on the skin available for cover; the use of homografts must be considered. There is no doubt at all that the ideal, in deep burns treated by exposure, is excision of the complete crust with *immediate* skin coverage, either by autograft, autograft and homograft, or homograft. To leave an area uncovered is to invite infection. Leaving out the possibility of immediate excision, the cover sequence in burns should be crust, then skin, whether the burn be superficial or deep, and there should never be a raw surface. One of the urgent necessities today is the training of teams for extensive rapid skin coverage.

The mixed superficial and deep burn has particular problems. The crust covering both the deep dermal injury and the deep burn tends to remain adherent. Frequently, when removing the crust about the sixteenth day in deep dermal burns, one tends to damage the new epithelial covering layer. Postponement in removing the crust, to allow of further healing of the deep dermal section of the burn, might lead to disregard of the optimal time for grafting of any deep section of the burn, and the healing process in such a burn might drag on for 3–4 weeks. On occasion, deep dermal burns are best considered as deep burns and, if the general condition of the patient is satisfactory, excision and grafting are carried out early.

Grafting

In our unit the over-all average time for excision and grafting has been the sixteenth day from the time of the injury. The grafts are applied preferably in sheets or strips; if made in postage-stamp sizes, they must be close together. The first dressing is removed on the third or fourth day and, whenever possible, the grafts are exposed throughout each day and covered at night. Exposure at this stage, by drying and cooling, counters the effect of surface proteolytic enzymes. On occasion, the exposure method has been successfully carried right through the grafting period.

I find it difficult to state the circumstances which indicate early exposure of grafts. Clinical experiments are being carried out with nylon covers in place of Tulle Gras, in an attempt to keep the parts cool and to diminish the chance of maceration and digestion.

Between the sixth and twelfth days, some patients with burns demonstrating skin loss and partial involvement of fat show signs of increasing intoxication, quite out of proportion to any mild local infection that might be present. Within a few hours of excision of the involved skin and underlying fat, followed by complete skin cover, there is dramatic improvement. What the nature of the toxic agent is I am not prepared to say. The picture gives support to a policy of early excision of deep burns. In burns involving over 20 per cent of the body surface I divide the surgical intervention into two procedures: (1) the excision of half of the crust area between the seventh and tenth days; (2) the second excision 10 days later. In extensive burns, the use of homografts is necessary. The employment of two surgical teams reduces the operative time by half, and gives the patient with extensive deep burns a chance to survive. One shudders to think of the unmanageable problem of mass casualties with many extensive deep burns.

Homografts

The grafting of skin from one person to another is generally considered to be unsuccessful. Although such grafts "take" initially, none persists except in the instance of identical twins. If it were possible to control the mechanism responsible for the

failure of survival of skin homografts, then the institution of skin banks would be feasible. There is evidence that the mechanism is based on an antigen–antibody reaction. The effectiveness of cortisone in controlling the immune response has suggested its possible use in prolonging the survival of homografts, but, unfortunately, carefully controlled experiments have not demonstrated any significant increase in survival-time. There is the additional disadvantage of increased scar-tissue formation beneath the homograft.

Infected burns

It is my practice to expose burns when the patient is admitted with these in the infected state, but, as in non-infected deep burns, the problem is different if the lesion is over 3 weeks old. In such cases cultures are made from the discharge, sensitivity tests are carried out, and the appropriate antibiotic is administered. It is generally appreciated that the repair of infected wounds is inhibited by the failure of lysis of dead tissue, and several methods for its removal have been suggested, including mechanical debridement and the use of chemical compounds (such as eusol). Changing the *p*H of the wound-tissue fluids has been suggested by the employment of pyruvic acid. Tillett and his associates (1950) demonstrated that from broth cultures of *beta*-haemolytic streptococci (Group A) a lytic factor could be isolated which liquefied human fibrin clots This lytic principle was in part a catalyst, which activated a fibrinolysing system in human serum—streptokinase—and also activated, in part, the enzyme desoxyribonuclease, to which was given the name of streptodornase. Both are without effect on living tissues, so that they can be employed to bring about the hydrolysis of fibrin and desoxyribonucleoprotein. They therefore tend to eliminate conditions which favour infection and to facilitate the formation of healthy granulation tissue.

One difficulty is the possible presence of antibodies to both the kinase and dornase factors after streptococcal infection. So far, in deep burns, the results following their application have been disappointing and may be due to anti-enzymatic factors present. Probably little advance will be made until an enzyme is developed which will digest collagen

For established infection with *Ps. pyocyanea*, promising results have been reported by Jackson, Lowbury and Topley (1951), using polymyxin as a local application.

Antihistamines in treatment

Reports on the use of antihistamine drugs in the treatment of burns vary from promising results to complete failure It is too early to come to any conclusion.

Burns due to electricity

The intensity of the amperage of the current which will affect man depends upon its voltage and upon the resistance of the body. If the body is well insulated it will not be damaged even by high-tension voltage. If the body is wet and well earthed it becomes a good conductor of electricity, and currents as low as 25 volts may be dangerous.

Electric burns may be divided into two types, (1) contact and (2) arc (Lewis, 1950) *Contact burns* vary from pin-point size to large surface areas; the *arc burn* is received from an extremely high temperature (2,500–3,000° C). The reaction may vary from a slight blister to deep tissue destruction.

Jellinek (quoted by Gaby, 1927) believes that electrical wounds caused by electric sparking and contact with high-tension current are different from thermo-electric and [illegible]

after the accident. The apparently healthy tissue surrounding the wound may become necrotic. This tendency to extension seems to be caused by alterations of the blood vessels: the current passes along their walls, which become friable and brittle; the endothelium is altered, and thrombi are formed and become attached to the intima.

Theoretically, the treatment is early excision of the affected tissues and grafting; but since the line of demarcation is so irregular or for some time non-existent, definitive surgery has often to be temporarily delayed.

Present-day position

Undoubtedly, considerable confusion of thought exists today, arising in the main from the fact that attention is focused on a local method, rather than on the principles on which a method should be based. Methods cannot be placed in order of acceptability nor is one method suitable under all conditions. The problems must be viewed without bias.

Many criticisms against the exposure method have been advanced—a few justified but most without justification. Prejudice can be eliminated only by willing personal effort, and practical criticisms, such as those based on chilliness and draughts, can be eliminated with due nursing care.

In warm humid climes, with which, in the Middle East, are associated flies and sandstorms, excellent results have been reported by Whyte (1951), working in these parts. Again, preliminary results in the exposure of burns, without the administration of antibiotics in any form, have been singularly successful, so that the good results previously published cannot have been entirely the result of penicillin. These findings are confirmed by Pulaski (1951).

I stress once again the basic fact of the attainment of a dry surface in local care, whether it be achieved as the result of exposure or of an absorptive dressing.

In considering mass casualties, one's approach must of necessity be modified, and one's views are dictated in the main by the appreciation of the number of casualties, relative scarcity of medical personnel, supplies of fluids and dressings, availability of voluntary-aid and Red Cross workers, and so forth The greatest necessity is the further education from basic principles of both medical and lay personnel in the care of possible "mass burns", with full appreciation of the realities should such disaster overtake us.

(*See also British Surgical Practice* Burns and Scalds, Vol. 2, page 518, S. Key 82.)

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EXOPHTHALMOS, MALIGNANT

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Introduction

The association of thyrotoxicosis with exophthalmic ophthalmoplegia and other eye manifestations has been known for nearly a century but it is only comparatively recently that the dissociation of the eye manifestations and the thyrotoxicosis has been recognized. Russell Brain drew attention to a series of patients in whom the main features were exophthalmos and ophthalmoplegia and in whom thyrotoxicosis as such played a minor part and in some instances was not present at all. To this group of patients he gave the name of exophthalmic ophthalmoplegia. The recognition of the essential disunity of the eye manifestations in thyrotoxicosis served a very useful purpose in drawing attention to the less-common manifestations which had been noted previously, but which had been regarded either as unusual complications or in many instances accepted as an association of another disease, in particular myasthenia gravis with toxic goitre.

It has since become apparent that there are many syndrome complexes involved, and whilst many of these show a considerable degree of overlap they occur as single entities. The superimposition of one on the other may lead to great complexity and has caused considerable confusion both in the assessment of the natural history and of the results of different forms of treatment in the various conditions.

There is in addition to the various manifestations of exophthalmos another entity which may occur alone; in association with goitre, toxic or non-toxic; or may be superimposed on the other exophthalmic syndromes. This condition, for which the term malignant exophthalmos will be used in order to avoid further multiplication of nomenclatures, consists of oedema of the orbit associated with congestion and oedema of the conjunctiva which is frequently progressive, and although at times there may be sudden unexplained regression, in many instances it leads to progressive infection of conjunctiva and cornea and to the eventual destruction of the globe of the eye.

It will be apparent that the clinical manifestations may seem extremely varied and complex because of the frequent superimposition of this feature on the other syndromes. When, however, this entity is seen alone its features are clear cut and distinct [illegible] ...gestion [illegible] degree of ophthalmoplegia related to the apparent severity of the oedema.

Classification

The aetiology and the exact pathology of the various co[illegible] exophthalmos are at present unknown. In an end[illegible]r to clarify the sit[illegible] the point of view of diagnosis, natural hist[illegible]ment, it [illegible] able to split the groups into a number of cl[illegible] which can be [illegible]er singly or in association, and although it [illegible] that with [illegible] this will have to be considerably modified [illegible] classificatio[illegible] tive purposes.

1. Malignant exophthalmos.

2. Benign exophthalmos.
   Without ophthalmoplegia,
   (a) Simple exophthalmos.
   With ophthalmoplegia (exophthalmic ophthalmoplegia),
   (a) Hypertonic exophthalmos.
   (b) Myopathic exophthalmos.
   (c) Myasthenic exophthalmos.

MALIGNANT EXOPHTHALMOS

Clinical features and course

The essential feature of this syndrome is the development of oedema and congestion of the conjunctiva together with exophthalmos. In the early stages the oedema appears more particularly in the lower fornix of the conjunctival sac and may be an apparently insignificant feature. As the condition advances the oedema becomes more gross and may result in an extreme degree of chemosis and the protrusion of large oedematous folds of conjunctiva from beneath the lids, rendering the closure of the lids mechanically impossible; superadded infection is inevitable.

The condition often appears unilaterally (Figs. 23 and 24) and the opposite eye



FIG. 23.—Unilateral malignant exophthalmos with simple nodular goitre.

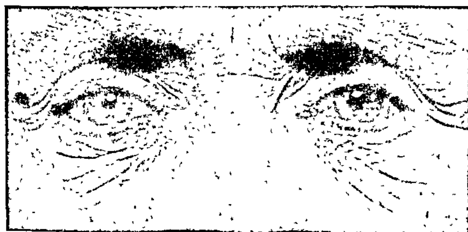


FIG. 24 —Same patient as in Fig. 23 after x-ray therapy to the orbit.

may be apparently entirely unaffected; not infrequently, however, both eyes are involved, but there is usually some asymmetry in the distribution. Another remarkable feature is the frequency with which the oedema is sharply delimited to the lower half of the conjunctiva. In many instances there is little abnormality to be seen in the upper half, and there may be none.

Although the degree of exophthalmos may be extreme the degree of conjunctival oedema is not proportional to it, and in many instances there is gross oedema with minimal exophthalmos (Figs. 25 and 26).

The onset of the condition is usually insidious, and the phase of the development of exophthalmos and oedema occurs gradually over the course of months. It is attended by frequent complaint of irritation and discomfort in the conjunctiva and



Fig. 25.—Bilateral malignant exophthalmos with toxic goitre. Decompression of both orbits had been undertaken three months previously. The right eye had been removed after perforation of the cornea post-operatively. Note the failure of tarsorrhaphy on left eye.



Fig. 26.—Same patient as in Fig. 25. Treated by irradiation to the orbits followed some months later by partial thyroidectomy and artificial eye in right orbit.

cornea, and these tissues appear to be unduly sensitive to both trauma and light. This feature often remains throughout the disease.

At times, however, the onset is abrupt and severe degrees of oedema may occur with startling rapidity, and the course of the subacute disease may be punctuated by episodes resembling those of acute onset.

In the early stages of the disease there is not of necessity any change in the eyelids. If the degree of exophthalmos is great then both the lids appear to be somewhat retracted in proportion to the degree of exophthalmos. In some instances there is disproportionate retraction of the upper lid but seldom of the lower lid, and in a number of others the opposite occurs and there is ptosis of the upper lid, often to a considerable degree. When the condition has been present for any length of time the lids will usually show the changes of chronic infection and blepharitis and may on this account appear congested and swollen. At this late stage too there may appear around the eyelids, and not infrequently around the face and neck, some degree of pigmentation. In malignant exophthalmos, in contrast with the changes in simple exophthalmos, this feature is often trivial and late, particularly when associated with toxic goitre.

External ophthalmoplegia is almost invariably present to some extent, but in the majority of instances there is largely a diminution or even absence of eye movement in various planes, in particular upward movement, rather than an individual external ocular palsy, although if the condition advances, or is present for a considerable length of time, various ocular palsies may supervene, in particular, perhaps, lesions of the external rectus muscle.

Internal ophthalmoplegia does not occur unless, as in very rare instances, there is involvement of the optic nerve and loss of vision.

It has frequently been said that disturbance of the visual fields does not occur. Although it must be admitted that it is by no means the usual course, loss of portions of the visual field is not infrequent, and in many instances this field defect remains even if the oedema regresses.

The natural history of this syndrome is extremely variable. In the majority of cases the condition once it has started is steadily progressive, commonly in a subacute manner, and it reaches a maximum over a course of months or years and may remain constant after this even for many years but with progressive diminution in eye movement and consequent progressive disability both in appearance and function. This course is, however, liable to a number of sudden fluctuations. Sudden exacerbation of the condition may occur at any time and may occur without obvious cause but is often precipitated by infection of the oedematous conjunctiva, or not infrequently after anaesthesia. These sudden exacerbations are much to be feared, as it is at these times that the major danger occurs to the eye itself, and, whether the exacerbation is induced by infection or [illegible] inadequate closure of the lids, a[illegible] may lead to a considerable loss [illegible] instances infection advances into the globe itself with disorganization and loss of the eye.

Occasionally the oedema regresses and even disappears spontaneously, but in the absence of infection or some obvious precipitating factor which can be overcome, this happy termination of the syndrome is infrequent.

Aetiology

This condition is predominantly a disorder of middle age, it is more frequent in females but is by no means rare in the male; and is certainly more frequent in men than is the development of toxic goitre (Figs. 27 and 28).



FIG. 27.—*Early malignant exophthalmos without evidence of thyroid disease.*



Fig. 28.—Same patient as in Fig 27 after x-ray therapy to both orbits.

The condition can arise without previous or even present manifestations of goitre, either toxic or non-toxic, and moreover there is no evidence that a goitre, or evidence of thyrotoxicosis, will of necessity supervene in the years to follow. It is not infrequent *in association with toxic goitre, and in many instances arises after the treatment of* [illegible] thyroidectomy. It can occur in association with a simple [illegible] occur when there are generalized *mani-* [illegible] xoedema.

The role of thyroidectomy in the aetiology of malignant exophthalmos has been stressed on a number of occasions. This has led to a considerable degree of confusion in that control of toxic goitre has often not been attained when malignant exophthalmos is present, owing to the fear of exacerbation of the eye manifestations by thyroidectomy, or by adequate medical treatment. Whilst there can be no doubt that the disorder *has frequently followed* partial thyroidectomy, there is often a long latent period—as long as 20 years after operation—although it is more usual for it to develop within 2 [illegible]
goitre in the pr [illegible]

cases, resulted not in exacerbation of the condition but in significant improvement or, at the worst, no deterioration.

Pathology

The pathological changes which occur in the orbit in this condition are ill-defined and considerable variation has been described, which may to a large extent be explained by the failure to recognize the primary changes from the secondary changes that occur when the condition is of long standing

In the early stages of the disease the orbital tissues are oedematous and the changes appear to affect very markedly the extrinsic muscles of the eye, which are grossly enlarged and hardened and give the appearance of gross oedema. Microscopically the oedema is evident, there is infiltration to a greater or lesser extent by lymphocytes, often patchily distributed in the muscle, and frequently there is evidence of muscle degeneration or destruction. The orbital tissue also shows a gross oedema and congestion, and not infrequently there is considerable round-cell infiltration outside the muscles as well as within the muscle groups

Whilst these changes appear constant in the early stage of the condition, in the later years, when the condition has become chronic, the major changes appear to be those largely of muscle destruction and fibrous replacement.

These changes as such do not appear to give a very adequate basis on which to explain the manifestations of the syndrome and would give the appearance of being non-specific That it may have a vascular origin is suggested by its occasional localization to certain portions only, as though it were by venous blockage, and indeed it is difficult to account for the natural history of the condition and the exacerbations which can occur with such rapidity except on the basis of a circulatory disturbance.

Treatment

It will be apparent that the assessment of the value of various modes of treatment of this condition is fraught with great difficulty The sudden changes which may occur for better or for worse, and the variable response of the exophthalmos to treatment of underlying conditions, especially toxic goitre, make it impossible to dogmatize on one course of action alone. The treatment, therefore, falls into two main groups, first the treatment of associated conditions and in particular toxic goitre, and second the treatment of the eye condition alone

When a toxic goitre is present with malignant exophthalmos the major difficulty arises as to whether or not it is safe to proceed with the treatment of toxic goitre on standard lines, and in particular as to whether or not partial thyroidectomy should be undertaken. It is considered by many that this is the one condition in which thyroidectomy is certainly not indicated

As has already been explained, this thesis is by no means proven. In fact there would appear to be every indication to control the toxic goitre, and whether this is controlled adequately by medical means or by partial thyroidectomy does not appear to make any significant difference. For whilst the eye condition gets worse on occasion there is no doubt that in many cases it improves, and as we already know that the natural history of this syndrome is in most cases steady progression there does not appear to be adequate reason not to give the patient the benefit of the control of the thyrotoxic element at the earliest possible opportunity.

The treatment of the eye condition is designed in the first instance to protect the eye from infection and exposure. If infection is already present treatment should be undertaken by suitable means and care exercised to ensure adequate cleanliness and protection afterwards If it be impossible to ensure this by simple measures, and there is considerable risk to the cornea, or the cornea is already showing evidence of

damage, then tarsorrhaphy will be required. However, it must be borne in mind that even this extreme measure will sometimes be unsatisfactory, because the tarsorrhaphy may tear and the oedematous folds of conjunctiva may protrude and thus make it as difficult as ever to control the degree of infection.

In mild cases, when the risk to the eye is small, it is wise not to undertake any special treatment at least for some months in the hope that spontaneous regression may occur. Although the evidence is not satisfactory, there does appear to be a suggestion that the administration of iodine, either as iodide or in organic combination as diiodotyrosine, does help significantly during this stage. The results will never be dramatic, but over the course of months improvement is often seen. The use of stilboestrol in the theoretical endeavour to prevent excessive activity in the anterior lobe of the pituitary on occasion has seemed to produce improvement, but in the majority of instances is not of obvious benefit. The use of thyroid extract or thyroxin does not appear to offer any advantage over iodine unless there be evidence of hypothyroidism, in which case it should be used instead of iodine, and is sometimes beneficial.

In the more severe degrees of this condition more radical treatment is required, or if a sudden exacerbation should occur it may be required at any time. For this purpose two lines of treatment are available, either surgical decompression of the orbit, or irradiation of the orbit with x-rays. If surgical decompression were uniformly successful this would appear to offer the best line of attack, but in a number of instances, in spite of immediate apparent improvement, the condition progresses afterwards. It would appear then that the most useful indications for surgical decompression are the immediate ones of relief of the intra-orbital tension and the protection of the globe of the eye when the globe is in jeopardy, particularly when tarsorrhaphy is unsatisfactory, and for cosmetic reasons. In the absence of these emergencies the use of x-ray irradiation of the orbit would appear to offer the best line of approach. Irradiation should be given slowly and the total dose should not as a rule exceed 1,000 r. Measures are taken, of course, to protect the lens as much as possible. The results of this treatment though not rapid are in many instances highly satisfactory, and the disappearance of oedema is often complete. The cornea and conjunctiva are abnormally sensitive, and a comparatively small dose of x-rays will induce discomfort ... care must therefore be taken ... irradiation affects only the ... s be superimposed on other exophthalmic syndromes the oedema may disappear but the other manifestations will be entirely unaffected. It must also be appreciated that however successful the response to irradiation or however good remission may be from any cause, the regeneration of destroyed tissue, either muscular or nervous, is clearly impossible—a fact which must be borne in mind if treatment is delayed for any reason.

More recently it has been suggested that the use of cortisone or ACTH may be beneficial. At present there is no good evidence that this will be uniformly successful, and in fact the contrary would appear to be general experience. It is too early at present to state categorically what effects may be expected, but its use may be attended by improvement, particularly if there be a superadded inflammatory exudate.

BENIGN EXOPHTHALMOS WITHOUT OPHTHALMOPLEGIA

Simple exophthalmos

Simple exophthalmos is the change most frequently seen in association with toxic goitre, though it may occur with simple goitre, with hypothyroidism, or without evidence of thyroid disease.

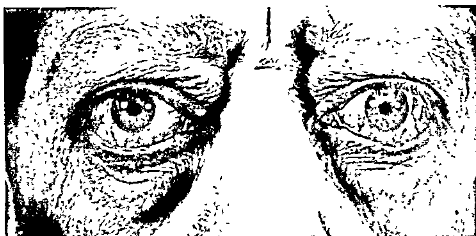


FIG. 29 —Simple exophthalmos.

Exophthalmos may be the only abnormality with both upper and lower lid apparently retracted in proportion to the degree of exophthalmos (Fig. 29). Disturbance of eye movement is not seen in this simple form, nor is there evidence of ophthalmoplegia. If the condition occurs acutely there is sometimes an initial complaint of diplopia without obvious clinical signs to explain it.

A frequent accompaniment to the exophthalmos is the presence of swelling of the eyelids, apparently the result of oedema, and the swelling often extends on to the face, together with a variable degree of pigmentation.

As is well known from the classical manifestations of the eye in toxic goitre, excessive retraction of the upper lid may accompany this exophthalmos, but in this disease there is no retraction of the lower lid to accompany it; in fact most frequently the reverse is true and the lower lid may be lifted up to reach the cornea from below in spite of the exophthalmos (Fig 30)

There is often considerable discomfort and excessive lacrimation in the eye which appears to be largely the result of excessive exposure, and if closure of the lids be incomplete at rest severe discomfort may arise from damage to conjunctiva and at times to cornea, in particular from the pillow during the night.

The natural history of this variety of exophthalmos shows perhaps even more



FIG 30 —Early hypertonic exophthalmos (left) without evidence of thyroid disease.

variability than malignant exophthalmos. Once the condition has developed it practically never disappears in its entirety; there is, however, often a considerable degree of improvement which follows the control of the toxic goitre which usually accompanies it. This improvement is, however, by no means the rule; progression may occur and the degree of exophthalmos may become extreme. Apart from the control of associated thyrotoxicosis no treatment seems to offer any reliable means of altering the natural history of this variety of exophthalmos.

BENIGN EXOPHTHALMOS WITH OPHTHALMOPLEGIA

Hypertonic exophthalmos

This condition is characterized by the development of exophthalmos, often unilateral and almost invariably grossly asymmetrical (Fig. 31). Like the two preceding conditions



FIG 31 —Severe right unilateral hypertonic exophthalmos with mild toxic goitre.

it may be seen with toxic goitre, it may occur alone, or it may be seen with simple [illegible] The dominant feature of this syndrome is excessive re- [illegible] ogether [illegible] quately to the movement of blinking, although by voluntary movement the upper lid may be closed completely (Fig. 32). As this condition progresses upward movement of the eye becomes impaired; at times movement is absent, as if the eye were fixed by the spasm of the upper lid retraction, presumably with spasm of some of the extrinsic muscles of the eye in addition. The exophthalmos is usually a direct displacement forwards, but in some in whom the lid retraction is extreme there appears to be displacement of the eyeball downwards as well as forwards. Diplopia is a very marked symptom even in the absence of obvious squint If this condition progresses, as it frequently does, external ophthalmoplegia, of lateral movement in particular, becomes a marked feature, and even with improvement of the exophthalmos the paralysis may remain.

In early cases of this type very considerable improvement may occur either spontaneously or after control of associated toxic goitre; in severer degrees the condition tends to progress until it reaches a constant state in which it may remain for many years with progressive ophthalmoplegia.



FIG 32 —Bilateral hypertonic exophthalmos with nodular toxic goitre.

Myopathic exophthalmos

The occurrence of generalized myopathy with toxic goitre is a well-recognized entity but it is seldom that the eye muscles are involved in this process when the condition is generalized. In some instances, however, a condition of myopathy of the extrinsic muscles of the eye appears to develop without clinical evidence of disturbance of the skeletal musculature, except the degree of muscle wasting, fatigability and hypotonicity associated so commonly with toxic goitre.

There is a varied degree of exophthalmos which is often mild, but there is an insidious onset of diplopia with the development of a squint usually as a result of paresis or paralysis of the external rectus. In the early stages there appears to be considerable variability from time to time in the degree of weakness but it is not related to fatigue of the muscle, it is not related to sleep, and even in the stage of weakness the muscle strength is not increased by Prostigmin. The outlook of this type is uniformly gloomy, and progression of the muscle to complete paralysis is usual; recovery very unusual. No treatment seems to make any significant difference, nor is there great hope of change from the control of an associated toxic goitre.

Myasthenic exophthalmos

[illegible]
the [illegible]
ma [illegible]

the body and without response to Prostigmin. As in myasthenia gravis, there is immense fluctuation from time to time, and the diagnosis may be very difficult. In spite of the lack of response to Prostigmin there is often great improvement and often complete recovery if there is a toxic goitre which is controlled adequately by medical means or by surgery, although recovery is usually slow.

(*See also British Surgical Practice* Eye in Relation to Endocrine Disturbance, Vol. 3, page 489, S Key 142.)

HEART SURGERY

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Although congenital malformations constitute only about 2 per cent of all cases of heart disease, the success of surgery for these conditions, especially direct cardiac surgery, has stimulated interest and advancement in the surgery of the more important field of acquired cardiac disease.

CONGENITAL HEART DISEASE

TETRALOGY OF FALLOT

Diagnosis

Further experience of the systemic-pulmonary anastomosis as suggested by Blalock and Taussig (1945) has shown this operation to give brilliant results in the Fallot type of lesion Bad results are obtained in pure pulmonary valvular stenosis, in cases in which the degree of pulmonary stenosis is slight (as in Eisenmenger's syndrome) and in those in which the degree of dextroposition is great.

Though the classical tetralogy of Fallot is easily distinguishable by routine clinical, radiological and electrocardiographic methods, cardiac catheterization and angio-

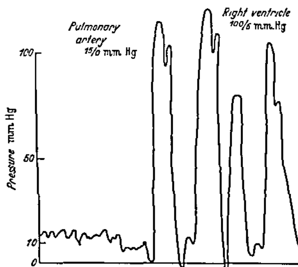
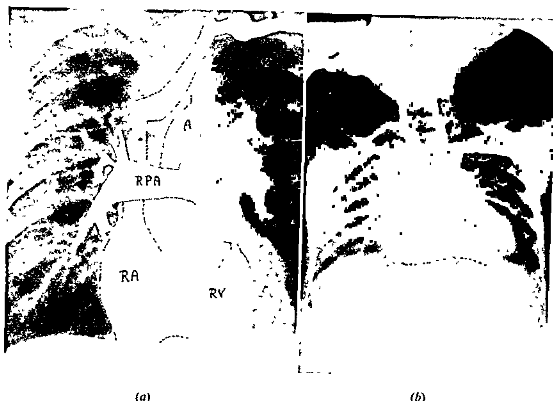


FIG. 33 —Cardiac catheter pressure tracing on passing from the pulmonary artery to the right ventricle in a case of tetralogy of Fallot (*after Holling and Zak*, 1950)

cardiography will be required in less typical cases. Catheterization (including arterial oxygen estimations) will, if the pulmonary artery is entered, give confirmation of the pulmonary stenosis by showing the fall in pressure when passing from the right ventricle to the pulmonary artery (Fig. 33) The exact site of the stenosis is difficult to determine by this method (Holling and Zak, 1950). By suitable passage of the catheter, ventricular and atrial septal defects may be shown and by determination of the oxygen saturation of the blood samples obtained, interventricular and interatrial shunts may be calculated, when the oxygen uptake is known.

Angiocardiography also demonstrates shunts, but it has the further advantage of demonstrating the anatomy of the cardiac chambers and the great vessels and, in cases

with a right-to-left interventricular shunt, especially, the disposition of the systemic vessels [illegible]
tion, [illegible]
cardia [illegible]
ventricular outflow tract. The oval opacity of the infundibular chamber is typical and the persistent spherical opacity of the valve cone in valvular stenosis enables a definite pre-operative diagnosis of the site of the stenosis to be made. The risk of the procedure



(a) (b)

Fig 34.—Postero-anterior angiocardiogram films at 2 seconds in tetralogy of Fallot. (a) High [illegible]

in cyanotic cases is about 3 per cent (Campbell and Hills, 1950), but it gives information of such value to the surgeon that it should be used whenever direct operation is considered, and in most cases in which anastomosis is planned and the risk is not considered prohibitive (Hill, 1952).

Choice of operation

The blood supply to the oligaemic lung may be increased by (a) encouraging the formation of vascular adhesions by pleurectomy, (b) deliberate anastomosis of a systemic artery to a pulmonary artery (formation of an artificial ductus arteriosus), and (c) direct relief of the stenosis (Brock and Campbell, 1950).

Indirect operation

Experience of reopening the chests of children with oligaemic lungs shows that vascular adhesions develop rapidly. Furthermore, cases which have had only a thoracotomy without anastomosis are known to improve their exercise tolerance after operation to a degree not accountable by training. Barrett and Daley (1949)

therefore set out deliberately to encourage these natural systemic-pulmonary anastomoses by excising the parietal and mediastinal pleura, and later by applying pleural irritants such as phenol and asbestos dust. Though the results of this procedure may be gratifying, they are not predictable and it is probable that indirect operations of this type should not be performed if there is a satisfactory alternative.

Anastomosis

The second type of operation comprises the Blalock-Taussig systemic-pulmonary anastomosis and the Potts' aorto-pulmonary anastomosis. These are well-established operations giving good results in long series of cases with proved overall mortality of less than 15 per cent. The results are not so good in cases of pulmonary stenosis with tricuspid atresia, single ventricle, dextrocardia or situs inversus with laevorotation and extreme aortic dextroposition, as they are in the uncomplicated tetralogy of Fallot. Blalock (1951) believes that a pulmonary stenosis with diagnosed single ventricle should not be subjected to the operation for creation of an artificial ductus unless there is very severe disability.

When it is possible to anastomose a branch of the aorta, this is preferable to using the aorta itself (Potts' operation) The risk of irretrievable mishap when using for anastomosis a structure of the importance of the aorta must be greater than with an easily controllable subclavian artery. Division of the carotid artery in these cases has a mortality rate of 30 per cent due to cerebrovascular complication and its elective use should therefore be avoided. In very small children the systemic vessels may be too small to give a satisfactory stoma and thus the Potts' operation is preferable. In about 20 per cent of cases of the tetralogy of Fallot the aorta descends on the right and on this side the interposition of the bronchus between the aorta and pulmonary artery makes aorto-pulmonary anastomosis difficult technically, if not impossible.

In left subclavian-pulmonary anastomosis the systemic artery may be so kinked over the aorta that blood flow is slight and there is a theoretical risk of stomal thrombosis. For this reason Blalock (1948) prefers the right approach in children between the ages of two and twelve years. On the other hand, it is found that though there may be slight flow initially through a left stoma, as the subclavian artery expands, the flow increases in a matter of days or months with corresponding improvement clinically. This may be of value in avoiding the risk of pulmonary oedema and the sudden strain on the left ventricle caused by the rapid opening of a large stoma

It is therefore a sound routine to approach by postero-lateral thoracotomy through the bed of the fourth rib on the side of the apex of the heart. In this way better operative approach for dissection of the systemic vessel is given than by anterior thoracotomy, the aorta itself is available for anastomosis if required, the anatomy of the heart may be inspected in cases of uncertain diagnosis, and with rib resection there is less risk of post-operative haemorrhage from the parietes than with an intercostal incision.

The routine left approach may well be modified by the angiocardiographic appearances. When there is doubt about the presence of one of the pulmonary arteries, it is customary to explore this side in the hope of finding a vessel large enough for anastomosis. To explore the side of the demonstrated pulmonary artery one must run the risk of clamping at operation the sole pulmonary artery. The disposition of the systemic vessels shown on angiocardiography may indicate that anastomosis without the use of a vessel graft is almost out of the question, for example right-sided aorta (Potts' operation not practicable), or high aortic arch and low right pulmonary artery (right subclavian-pulmonary anastomosis impracticable without a vessel graft), or absent left subclavian artery (only left carotid available with a 30 per cent mortality for left anastomosis), but an infundibular stenosis with a chamber present which is suitable for direct operation (Fig. 35).

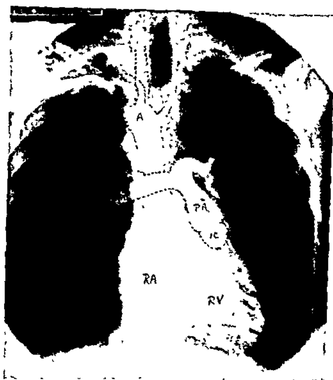


FIG. 35.—Postero-anterior, 2 second, angiogram [illegible]

(*see text*).

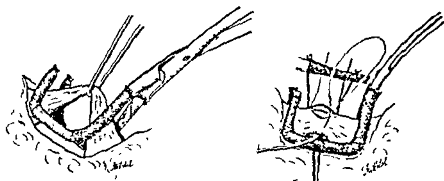


FIG. 36.—The Derra pulmonary artery clamp in use for left-sided end-to-side subclavian-pulmonary anastomosis.

The technique of the anastomoses has not advanced significantly since the orig descriptions by Blalock and Taussig (1945) and Potts, Smith and Gibson (19 but the use of the pulmonary artery clamp devised by Derra of Dusseldorf simpl the methods of occluding and stabilizing the vessel, and there is less risk of tearin thin pulmonary artery in an end-to-side anastomosis (Fig. 36). The chest sho always be drained; excessive oozing is common in these patients, particularly in older age-groups, and unrelieved post-operative haemothorax is a potent cause post-operative death. Operators in Great Britain have found that heparin and ot anticoagulants are neither necessary nor desirable.

Direct operation

Though the creation of an artificial ductus gives good results in the treatment of Fallot's tetralogy, it creates a further defect for which, when it occurs naturally, operative closure is usually advised; it does not alter the cardiac abnormality, and it throws an additional strain on the left ventricle. As time progresses the unrelieved pulmonary stenosis increases until the pulmonary artery may be obliterated. The patient is then in the undesirable position functionally of having a single ventricle with a truncus arteriosus—a condition which, when occurring naturally, is of known bad prognosis.

Brock and Campbell (1950) have directed attention to an attack on the pulmonary stenotic area in the belief that the relief of the stenosis will not only increase the pulmonary blood flow, but will also diminish the aortic flow from the right ventricle. The shunting caused by the degree of aortic dextroposition is not, of course, altered.

Anatomy.—In about 40 per cent of cases of Fallot's tetralogy the stenosis is at the valve level, the valve being represented by a fibrous diaphragm with a small central orifice (Fig. 37*a*) In systole the valve is blown into a cone, which at operation may be clearly felt as a high-tension hemisphere bulging in the root of the pulmonary artery. Pulmonary sinuses of Valsalva are usually absent and a marked post-stenotic dilatation of the artery, extending into the branches, is nearly always present. These features may be well demonstrated by angiocardiography (Fig 38)

In the remaining cases the stenosis lies in the infundibulum or outflow tract of the right ventricle. Though there is a general narrowing of the muscular portion of the outflow tract, examination of fixed autopsy material gives little idea of the dynamic channel found at operation and Brock (1951) has described the various types of

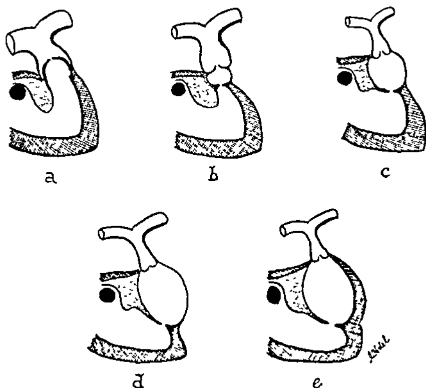


FIG 37 —Diagrams to show the outflow tract of the right side of the heart [illegible]



FIG 38.—Oblique 2-second angiocardiogram of a tetralogy of Fallot with valvular stenosis, verified at operation, *showing the valve cone (V).*

infundibular stenosis, maintaining that there is mostly present an annular or short stenosis amenable to surgical relief. This narrow stenotic area may lie immediately below the valve (high) when the post-stenotic dilatation affects the pulmonary artery (Fig 37*b*), intermediate in position when it is separated from the valve by a small infundibular chamber (Fig. 37*c*), or low in position where a large chamber, sometimes with a muscular wall (Fig. 37*e*) or a thin wall (Fig. 37*d*) separates the stenosis from the valve.

Indications and contra-indications.—The absolute indication for direct operation is an absence of any systemic vessel suitable for anastomosis with the pulmonary artery.

Relative indications for the direct attack in the hands of the experienced cardiac surgical team are (1) valvular stenosis in tetralogy, (2) intermediate infundibular stenosis with a well-defined chamber, (3) excessive hilar collaterals making dissection of the pulmonary artery difficult and dangerous, (4) extensive vascular pleural adhesions in the presence of which only local approach to the pericardium is possible without dividing adhesions.

Contra-indications to direct attack are (1) in children under the age of 2 years, the chambers being small, (2) in patients over the age of 20 years, when the operation carries a high risk and vegetations and calcification are present at the stenosis, (3) high infundibular stenosis, where resection of the stenosis may damage the valve, and (4) atresia of the right ventricular outflow tract or main pulmonary artery.

Operation.—Though right ventricular cardiotomy may be carried out through a left postero-lateral thoracotomy, the antero-lateral approach is preferred. A subpectoral skin incision is made and the pectoral musculo-cutaneous flap is raised to expose the third left intercostal space, which is incised. The serratus is split and retracted and the intercostal incision is carried well posteriorly. After securing the internal mammary vessels, the third and fourth costal cartilages may be divided and the ribs spread.

The pericardium is anaesthetized by the instillation of 2 millilitres of 0·5–1 per cent amethocaine; stronger solutions are liable to give rise to chemical pericarditis. Continuous intravenous injection of procaine at the approximate rate of 1 gramme per hour greatly reduces the risk of cardiac irregularity.

The vascular pleura is reflected from the anterior surface of the pericardium and, not less than four minutes after the application of the pericardial anaesthetic, the pericardium is incised anterior to the phrenic nerve and the anterior flap reflected to expose the right ventricle, the interventricular groove and the main pulmonary artery.

The right ventricular outflow tract is then palpated to determine the site of the stenosis and the planned area of the incision is infiltrated with up to 10 millilitres of 0 5 per cent procaine. The incision should be in the axis of the outflow tract, at right angles to the superficial layer of muscle and not less than 1 centimetre below the estimated site of the stenosis Frequent pauses are made to allow inflation of the lungs and to permit any cardiac irregularity to settle. A small incision is made down to the endocardium and if there is any doubt of the exact site of the stenosis, a cardiac catheter may be inserted into the ventricle and note made of the exact site of pressure change as recorded on an electromanometer. No stay sutures are used, as these are more likely to lacerate the muscle if any attempt is made to position the heart with them. If the heart requires rotation or displacement to the left, traction on the anterior pericardial flap should be made.

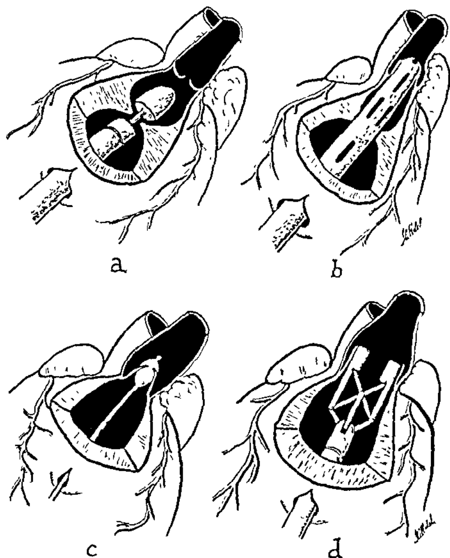
A curved paraffined cardiac probe is first inserted and this will pass easily into the aorta The probe should be held in the right hand and the heart steadied with the left index finger As the probe is directed towards the pulmonary artery it will be felt to pass to the left of the crista supraventricularis and the left index finger should be placed on the pulmonary artery to palpate the point of the probe. The site of the stenosis having been verified, the probe is withdrawn and the ventricle wound controlled with the left index-finger tip. If the stenosis is infundibular, an appropriate size of punch is then inserted in the same direction as the probe went, the left index finger being shifted to rest on the pulmonary artery to check its position and direction. As soon as the tip passes the stenosis the jaws are opened (Fig. 39*a*) and then closed about the stenosis, the ring of which is resected and held in the punch, and the punch withdrawn, the ventricular wound being controlled as before. This may be followed by the passage of fenestrated dilators (Fig. 39*b*), which allow some circulation in the pulmonary artery whilst they are in place. No instrument should be allowed completely to block the right ventricular outflow for more than a few beats. If, in low infundibular stenosis, the incision has been made in the muscular infundibular chamber, the punch will have to be passed towards the apex of the ventricle to deal with the stenosis.

If the stenosis is valvular, a simple probe-pointed valvulotome is inserted in the same way as the punch, to produce a linear slit in the valve diaphragm (Fig. 39*c*). The fenestrated dilators may then be passed, followed by an expanding dilator, the jaws of which are opened to split the valve to its ring (Fig. 39*d*). The pulmonary arterial route to the valve, with or without the use of an operating cardioscope, has been practised, but is at present less satisfactory than the ventricular approach.

The heart wound is then closed with simple sutures of No. 60 linen thread or corresponding silk, not passing as deeply as the endocardium, inserted with a curved needle under the controlling finger tip. They should be tied just firmly enough to stop the leakage and only rarely are more than three sutures required.

The pericardial flap is then loosely re-sutured, an axillary basal drainage tube is inserted and the chest is closed by wiring the ribs and suturing the soft tissues.

The heart usually tolerates these manoeuvres well, providing the oxygenation is always adequate, quinidine has been given pre-operatively, and adequate use is made of local analgesic and intravenous procaine to reduce its irritability. Gross irregularity during these manipulations calls for rest periods, and excessive fall in



Fi [illegible] ...into the right [illegible]

blood pressure may be corrected by an intravenous vasopressor such as methedr (10 milligrams). The use of such a drug must be carefully controlled, for its inject before cardiotomy is complete may give such a powerfully acting heart that cont and suture are difficult. Cardiac asystole occurring during the operation should *treated by intra-auricular (left appendage) injection of 1–2 millilitres of 1:10,0 adrenaline, and massage carried out to maintain the circulation until normal b is re-established. Ventricular fibrillation, as confirmed by electrocardiogram,* treated by further procaine, electric shock (1 ampere A.C. for 1 second) to arrest t heart, followed by massage to restart it. It is important that there should be meticulo time-keeping from the time of cessation of effective circulation, for resuscitat measures must be applied before irreversible cerebral and cardiac change occur and the surgeon's conception of time in such emergencies is likely to be faulty.

Pure Pulmonary Valvular Stenosis

Pulmonary valvular stenosis without ventricular septal defect causes raised rig ventricular pressure. At this stage any cyanosis present is due to peripheral stasi

As the ventricular pressure rises, the right atrial pressure rises and tricuspid incompetence may develop. The foramen ovale may reopen and a reversed right-to-left interatrial shunt may occur, giving rise to central cyanosis.

It is essential to differentiate this condition from pulmonary stenosis with ventricular septal defect, and this may be done by cardiac catheterization to show the raised right ventricular pressure and low pulmonary artery pressures Even in asymptomatic cases the right ventricular pressure may reach 200 mm. Hg. Angiocardiography confirms the absence of interventricular shunt and shows the slow emptying of the right ventricle (Fig. 40). Progressive right ventricular enlargement and failure occurs, and sudden death is a clinical feature of the disease.

Operation

Creation of an artificial ductus in cases of pure pulmonary valvular stenosis does nothing to relieve the right ventricular strain and by raising the pulmonary artery

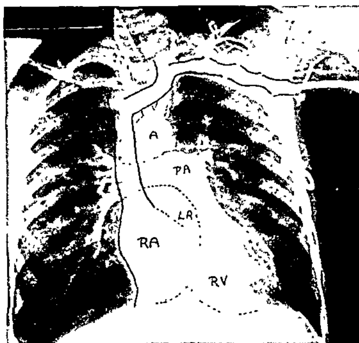


FIG 40 —Postero-anterior angiocardiogram, 4-second film of pure pulmonary valvular stenosis, verified at operation, showing persistent filling of the moderately dilated pulmonary artery (PA) The aorta is beginning to fill from the reversed interatrial shunt (A)

pressure may, in fact, increase it. The creation of a leak from the high-pressure systemic to the low-pressure pulmonary system throws a strain on the left ventricle and the cases rapidly go into failure. Following the lead of Brock (1948) and Sellors (1948) in Great Britain, it is generally agreed that pulmonary valvulotomy is the operation indicated It should be carried out as the operation of valvulotomy described for Fallot's tetralogy, but in the absence of ventricular septal defect the instruments are more easily passed into the pulmonary artery. If cardiac arrest occurs during operation, it is important to divide the valve to relieve the right ventricular strain before attempting to resuscitate the heart.

The operation should be performed as soon as the raised right ventricular pressure is diagnosed, but preferably after the age of 4 years, and before gross right ventricular

enlargement and failure occurs. Mortality is then low. If operation is delayed until cyanosis is marked, disability is severe and right-sided failure is present, operative mortality is high; but the outlook is so bad without operation that even at this stage pulmonary valvulotomy should be performed.

Results of direct operations for congenital heart disease

Brock (1951) in 52 pulmonary valvulotomies has had 10 deaths (19 per cent mortality); 27 of the cases were of pure pulmonary valvular stenosis and 8 deaths (30 per cent mortality) occurred in these, though several were late cases with failure. In 25 cases of Fallot's tetralogy there were only 2 deaths (8 per cent) and these were in adults. With infundibular resection for Fallot's tetralogy there were 7 deaths in 24 cases (29 per cent mortality).

The functional results of valvulotomy in successful cases show as much improvement as with a successful anastomosis, and there is no evidence of pulmonary regurgitation. The results of infundibular resection may be equally brilliant, but are at present less predictable.

Transposition of the Great Vessels

In this condition the aorta arises from the right ventricle and the pulmonary artery from the left Ventricular septal defect must be present for the maldevelopment to be compatible with life.

External systemic-pulmonary anastomosis gives little improvement; but some gain may be obtained by increasing the intracardiac mixing by creating an artificial atrial septal defect. In 1948 Blalock and Hanlon published an experimental method for creating such a defect and there are encouraging but not satisfying results from its application to cases of transposition (Blalock, 1951).

At the operation, by right antero-lateral thoracotomy, the right pulmonary artery is controlled. The distal end of the right superior pulmonary vein is occluded and a specially designed curved clamp is applied to occlude a bay of the right atrium where it has a common wall with this pulmonary vein. It is possible to open this atrial bay, excise the intervening septum, sew the edges of the defect and close the atrial incision without interrupting the circulation.

Anomalies of the Venous Return

Persistent left superior vena cava usually drains into the right atrium *via* the coronary sinus and is of no clinical significance. The left caval drainage into the left atrium may produce cyanosis and is usually associated with some other cardiac anomaly. Such a vein may be ligated in the definitive operation to correct the associated cardiac abnormality.

Pulmonary venous drainage into the right atrium is shown by raised oxygen tension in the blood of this chamber and such veins may be detected directly by the exploring catheter. This drainage increases the pulmonary blood flow and, ideally, such veins should be transplanted into the left auricular appendage. Such stomata thrombose easily, but Muller (1951) has succeeded in such an anastomosis.

ACQUIRED HEART DISEASE

Mitral Valvular Disease

Direct attack on the stenotic mitral valve by the atrial route, without success, was reported by Allen and Graham in 1922. Souttar in 1925 performed a successful digital dilatation *via* the auricular appendage. Ventricular approaches were reported by Cutler and Beck in 1929; but the results of resection of the valve by this route were bad.

There was little further advance until Bland and Sweet (1949) reported the results of venous shunts between the vena azygos and the right inferior pulmonary vein, to relieve the episodes of pulmonary congestion. Harken and his colleagues in 1948 and 1950 reported the use of extracardiac venous shunts, the creation of atrial septal defects and punch resection of the valve with varying degrees of success.

In 1950 Baker, Brock and Campbell were able to report on 9 cases of mitral valvulotomy with 7 successes, and Bailey, Glover and O'Neill (1950) recorded 22 cases with 11 survivals One year later Brock (1951) was able to report 50 cases with 8 deaths, only 1 death occurring in the last 30 cases.

This improvement is in part due to the development of anaesthesia, antibiotics, transfusion and general thoracic technique, but is in the main due to increased knowledge of handling the heart, much of it learnt from the direct surgery of congenital heart disease, the awareness of the value of procaine in reducing cardiac irregularity and the appreciation of the importance of the integrity of the mitral valve and cordae, and in particular the anterior cusp. It is appreciated that the auricular approach produces less cardiac irregularity and is easier and safer than left ventricular cardiotomy. Though Murray (1949) has reported successful resection of the mitral cusp and replacement of venous flap, the practical approach, until independent circulation is further developed, is by splitting of the valve to increase the orifice without impairing —perhaps even improving—its competence.

Morbid anatomy

The two cusps of the normal mitral valve bulge into the atrium during ventricular systole, with their edge surfaces in apposition. Not only is reflux into the atrium prevented by the cordae holding the valves opposed; but the larger antero-medial cusp, forming functionally part of the wall of the left ventricular outflow tract, directs the blood into the aorta. The efficiency of this mechanism depends thus on the accurate apposition of supple valve cusps, retained by cordae and papillary muscles and on the integrity of the aortic cusp directing the outflowing blood.

In the valve affected by rheumatic disease, the following processes impair its function: the valve ring itself may be narrowed; the cusps fuse, narrowing the orifice and thus hindering the flow of blood into the left ventricle; the cordae shorten and become matted and the cusps become firm and even calcified, thus preventing accurate apposition and permitting regurgitation. On palpation, such a mitral valve feels an almost immobile diaphragm with a firmly margined oval aperture, the size of a finger tip. In contrast, the normal valve feels like a sail billowing back into the atrium in ventricular systole.

The object of the operation of mitral valvulotomy is to enlarge the mitral orifice, free the cusps and cordae, to allow better apposition and mobility, without damaging the cordae or cusps. The conception that mere enlargement of the orifice is the prime object of the operation is false, as is shown by the failure of the punch operations. Damage of the retaining cordae or of the cusps, particularly the aortic, is followed by [illegible]

split; but it is less easy to follow the line of the commissure with a knife than with the finger, and there is greater risk of damage to the cusps, cordae and papillary muscles.

Selection of cases

The prime indication for operation must be established mitral stenosis with disability Treatment must be considered in relation to the natural history of the disease. It is well known that patients with mitral stenosis may survive to an old age; but the

physician has become very tolerant of the limitations imposed on the patient by regimen of medical treatment. That the disabled patients have not become so c placent of this state of affairs is indicated by the demands for operation; dem which often persist no matter how high the operative risk is placed. The follo factors are to be considered in selecting cases:

Presence of active rheumatism.—Active rheumatic processes in the valve or n cardium contra-indicate operation. Every effort must be made to exclude acti and for this reason patients under the age of 18 years should rarely be considered valvulotomy. The risk of recurrent carditis after operation will be less if the pati are over 30 years of age; but operation on the disabled in the third decade should be refused on the age ground alone.

The presence of Aschoff nodes in the myocardium of cases undergoing valvulot

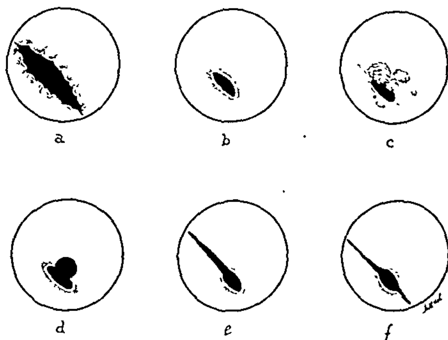


Fig. 41.—The mitral valve at operation: (*a*) the normal valve; (*b*) typical stenotic valve, fused at the commissures; (*c*) calcified valve; (*d*) punch of the anterior cusp giving regurgitation, (*e*) lateral commissure split; and (*f*) both commissures split.

is common, yet re-stenosis has not been reported so far. It seems that the conceptic that the Aschoff node indicates an active rheumatic process should be modified.

Involvement of other valves.—Marked aortic valvular disease should be regarded a contra-indication. Good results have attended mitral valvulotomy in the presen of minor degrees of aortic regurgitation; and in this connexion the Graham Ste murmur of pulmonary regurgitation should not be confused with the aortic diastol murmur.

Mitral regurgitation.—Most stenosed mitral valves have some degree of regurgit tion, and a regurgitant stream may be felt by a f r in the atrium in cases in which mitral systolic murmur was not audible cli operation it may be possibl so to free the valve th urgitation is le llows that minor degrees o regurgitation are dication to but cases with regurgitatio of an extent to pro rked left vent ement, systolic pulsation o the left atrium visib g, or aneu n of this chamber, shoul be regarded as unsu tion. Th urmur shoul not be regarded as a ion of the

Calcification of the valve.—Heavy calcification of the valve may indicate operative difficulty and increased risk from emboli; but many calcified valves split easily, and calcification by itself should not be regarded as a contra-indication.

Pulmonary hypertension.—As the mitral valve narrows, the right atrial pressure rises. Following this, the pulmonary capillary and arterial pressures rise, though the mechanism of this change is not completely understood. The right ventricular pressure also rises and in time irreversible sclerotic changes occur in the pulmonary vascular bed. Once these permanent changes have occurred, valvulotomy will produce little relief of the pulmonary hypertension The earlier hypertension with episodes of pulmonary oedema and haemoptysis is, however, dramatically relieved by valvulotomy and these manifestations are urgent indications for operation.

Auricular fibrillation.—Though cases with auricular fibrillation carry a higher risk of serious irregularity during operation and of systemic emboli, the arrhythmia should not be regarded as a contra-indication, but more as an added risk indicating that the optimal time for operation is past.

Secondary right-sided heart failure.—It is obvious that the operative risk is less and the chance of improvement greater if the myocardium is undamaged. On the other hand, relief of the stenosis will throw less strain on the damaged myocardium. Thus myocardial damage should not be regarded as a contra-indication to surgery unless the risk is felt to be prohibitive

Age of the patient—The lower age limit for the operation is determined by the fear of active or recurrent rheumatism in the first and second decades. The upper age limit is determined by the patient's general physical condition and the state of the myocardium and the duration of the disease. Present experience indicates that the risk is difficult to justify over the age of 50 years, but that this figure should not be regarded as by any means absolute.

The most suitable type of case for operation will therefore be the disabled patient in the fourth decade, with relatively pure stenosis, a normal rhythm and a low output, high (pulmonary) tension, small heart

Investigation

The clinical history, particularly of disability and pulmonary hypertensive episodes, is most important Clinical cardiological, radiological, screening and electrocardiographic examinations are routine. From the point of view of comparative assessment, cardiac catheterization, both resting and after exercise, is valuable in determining the right ventricular and pulmonary artery pressures and estimating the cardiac output. When the catheter findings and the clinical assessment clash, it will usually be wise to follow the clinical evaluation.

Pre-operative measures

A short period of rest in bed before operation is desirable, and during this time any evidence of right-sided failure will be treated on the established medical lines. If fibrillation is present, the ventricular rate will be stabilized with the appropriate regular dose of digitalis or its derivative. In cases not fibrillating, it may be wise to give quinidine to reduce the ventricular irritability. After a preliminary test dose of 2–5 grains by mouth, the course of 5 grains 4 hourly is started so that at least 2 doses will be given before operation

The sudden onset of pulmonary oedema with excitement before operation or at anaesthetic induction must be treated energetically by venous tourniquets, atropine by injection, morphine and theophylline ethylenediamine. The risk of pulmonary oedema during anaesthesia may be lessened by starting an intravenous drip infusion of procaine 0 2 per cent in 5 per cent glucose solution in the ward and giving at least

250 millilitres of this before induction of the anaesthetic. This infusion will be arranged so that it is possible to use blood at any time. Though the blood loss is rarely severe, when haemorrhage is torrential, intra-arterial transfusion, preferably with oxygenated blood, will cope with the situation when corresponding intravenous transfusion will fail. When particular difficulties are encountered or anticipated it may be wise to have an arterial transfusion cannula inserted in the radial artery in preparation.

Endotracheal anaesthesia is the rule. Thiopentone-curare sequence with a high percentage oxygen inhalation has proved satisfactory and ether is preferable to cyclopropane.

Operative technique

Left antero-lateral thoracotomy through the fourth or fifth interspace, with subpectoral incision carried well posteriorly, gives an excellent approach. It should be remembered that the high-tension pulmonary artery lies in contact with the costal cartilages.

The pericardium is exposed and from 2 to 5 millilitres of 0·5 per cent amethocaine are instilled. The pleura is incised anterior to the phrenic nerve, which is displaced posteriorly, and the anterior pericardial pleura mobilized. Not less than four minutes after the instillation of the pericardial anaesthetic an anterior pericardial flap is cut, exposing the left auricular appendage and the pulmonary artery. The wall of the base of the appendage and the cardiac plexus in the aorto-pulmonary interval are infiltrated with 0 5 per cent procaine. Atrial pressure may at this stage be measured with a needle and manometer.

The base of the appendage is then clamped with a light non-crushing angled clamp, care being taken that the tips of the clamp lie well clear of the tense pulmonary artery. It may be possible to apply a suitable curved clamp with the handles toward and the points away from the artery The lateral surface of the appendage is then incised distal to the clamp and after any adherent clot is teased out the interior of the appendage is inspected. A clot compressed within the jaws of the clamp may be flushed out by cautiously loosening the appendage clamp; but the extent of organized adherent clot may be such as to make insertion of the finger impossible.

Two interlocking purse-string sutures are inserted distal to the clamp and the right index finger inserted as the clamp is loosened. It is rarely necessary to pull the purse-strings to close the appendage about the finger, which engages in the isthmus at the base of the appendage. Once the finger is inserted it is safer to remove the appendage clamp to avoid damage to the pulmonary artery, which may be 4 centimetres in diameter, and the pericardial incision must be large enough to allow this always to be seen. If there is difficulty in passing the finger beyond the isthmus of the appendage it is probably wiser to work with the appendage invaginated or to use a smaller finger, rather than to risk splitting the appendage into the friable atrial muscle close to the atrio-ventricular groove with the left coronary artery.

The enlargement of the right atrium does not affect the distance between the valve and the appendage, and the finger tip will easily locate the oval orifice in the tense diaphragm and a regurgitant stream may be palpable. The characteristic orifice is about 1 centimetre long and 0·5 centimetre wide. Pressure with the finger pulp is made against the lateral commissure to split it as far as possible to the ring of the valve. External counterpressure with the thumb or left hand may be required. It may then be possible to split the shorter medial commissure with the back of the finger, or with the pulp, if necessary pronating the hand. So much additional mobility may be given by the lateral commissural split that the medial commissure retreats before the finger. It is therefore wise to attempt to split the medial commissure first in thin valves. After the valve is widened it is possible to pass the finger tip into the ventricle

and separate the adherent ... papillary muscles. During ... orifice should not be blocked ...

When digital pressure ... may be required to ... are safer to use than the ... cordae. The use of the ... damage. In the most ... into the atrium during ... palpable.

As the finger is removed ... amputated and the appendage ... linen thread and tightened ... to ligate the base of the ... again; it falls from a ... centimetres of saline ... systemic blood pressure ... required intravenously

The pericardium is ... an axillary basal ...

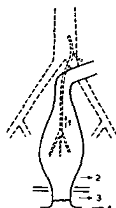
RESECTION

F R.C.S.
...ITAL, LONDON

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...HOLOGY

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Aortic Valvular Disease

The problem here is greater owing to the proximity of the coronary arteries; the high pressure of the systems involved and the severe effects of aortic regurgitation. Any attempt at relief of acquired aortic stenosis must be accompanied by reconstruction of the valve, and any artificial valve flap so inserted must not occlude the coronary orifices. Attempts have been made to approach the aortic valve, using an operating cardioscope, through the distal aortic branches and through the left ventricle; and blindly through the left ventricle and through the left auricular appendage *via* the mitral valve. This last route runs a great risk of damage of the antero-medial mitral cusp.

Though some progress is to be expected, it is unlikely that there will be major advance in this field before the use of independent circulation is made practical in man.

(*See also British Surgical Practice* Vascular Surgery, Vol. 8, page 489, S. Key 343

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RECTUM—RESTORATIVE RESECTION OF

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During recent years there has been a renewed and widespread interest in those operations for rectal cancer which, though radical, yet preserve the function of normal defaecation. Concomitant with this, some doubt has been expressed as to the effectiveness of the usual abdomino-perineal or combined operation in certain rectal growths and a tendency to adopt yet more radical measures. These views are not necessarily antagonistic: they are based on the pathology of rectal cancer and an increased awareness of its spread.

PATHOLOGY

Lymphatic spread

We owe to Miles (1908) the first sound description of the spread of rectal cancer (Fig. 42). Subsequent work by Gabriel, Dukes and Bussey (1935) and many others, based mainly on the careful dissection of specimens removed by abdomino-perineal or other form of combined excision, showed the importance of the upward lymphatic spread and the rarity of downward lymphatic involvement except in advanced cases

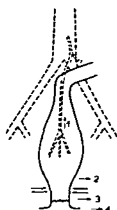


Fig. 42.—Lymphatic drainage of the rectum (*after Miles*): 1, lymphatics accompanying inferior mesenteric artery; 2, middle haemorrhoidal, and 3, inferior haemorrhoidal paths; 4, lymphatics to inguinal glands

where the glands above are blocked by growth. Dukes (1950), in a survey of 830 specimens removed by combined excision, found spread beyond 5 centimetres below the growth in only 2 per cent, and 75 per cent of such cases were found to be in tumours [illegible]

While the evidence on the common upward spread and the uncommon downward spread was unassailable, real evidence on lateral spread was somewhat uncertain since the lymphatics draining the rectum laterally pass to glands on the side wall of the pelvis, and these glands are not removed in the standard combined excision. Much evidence during the past decade has shown the importance in prognosis of the actual site of the growth. Thus Gilchrist and David (1947) found that the 5-year survival rate after abdomino-perineal excision for cases with lymph-gland involvement (C cases) was 51 per cent for growths above, and only 37 per cent for those below the peritoneal

reflection. The local recurrence rate in the same group (C cases) was 23 per cent for low and only 3·6 per cent for high growths. Waugh and Kirklin (1949) found similar results, the best prognosis being for growths more than 11 centimetres from the anus. Guernsey, Waugh and Dockerty (1951), reviewing 210 dissected specimens removed by abdomino-perineal excision, again confirmed these findings as regards prognosis, but found no evidence of lateral spread in their material though they, like others, attributed the worse prognosis in low growths to increased lateral spread. In fact, if lateral spread was the cause of the worse prognosis in low rectal growths there was no evidence in their investigations that the abdomino-perineal operation performed had done anything to remove the infected lateral lymphatic area. So far as the actual levator ani muscles are concerned, all evidence suggests that their involvement is only by the direct spread of the growth.

Wangensteen and Toon (1948) reported a local recurrence rate after restorative resection of the rectum similar to that reported by others after the abdomino-perineal operation. Local recurrence occurred in 25 per cent of cases when the growth was within 6–8 centimetres and in only 6·3 per cent of cases when it was 9–13 centimetres from the anus.

Anatomically there is evidence that the rectum can be divided into two parts by its

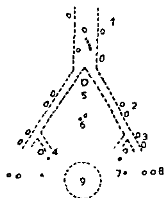


Fig. 43.—Lymph glands outside the para-rectal and inferior mesenteric groups which may be involved in rectal cancer; 1, [illegible]

lymphatic drainage system. Villemin, Huard and Montagne (1925) showed that the lymph flow from the upper rectum is upwards, while that from the lower rectum is laterally, downwards and upwards. Similar findings have been reported by Sauer and Bacon (1951) and the division between upper and lower rectum, where the lymphatic drainage alters, is stated to be at the middle valve of Houston, the usual level of the peritoneal reflection and some 3–4 inches (8–10 centimetres) from the anal margin.

Morgan (1950) points out the intimate relationship of the lower rectum to the pubococcygeus portion of the levator ani and the pelvic fascia and that the lymphatics of these structures, apart from the lateral ligaments, offer a choice of lateral spread. This contention is a sound one though the published evidence of lateral spread removed at operation has been obtained more frequently by clearing the side walls of the pelvis and the division of the lateral rectal ligaments close to the pelvic wall, than by the removal of the levator ani muscles

Deddish (1950) found that of 150 patients having residual rectal cancer after abdomino-perineal excision, 50 per cent had lesions in structures within the pelvis while the remainder showed secondaries in the liver, lungs, brain, skeleton and sub-[illegible] He considered that involvement of the obturator and hypogastric [illegible]

others advise a much more extensive lymph gland [illegible] excision of other pelvic structures in contact with the growth, such as the uterus,

vagina and seminal vesicles. In a series of 25 cases having abdomino-pelvic lymph gland dissections (para-aortic, sacral promontory, iliac, hypogastric and obturator) 24 per cent showed metastases in glands other than those in the para-rectal and intermesenteric groups, the usual lymphatic glands removed by the abdomino-perineal operation. His results are interesting. In only one case was the primary growth above 6 centimetres from the anus. Here it was 17·5 centimetres up and a C case as regards the glands in the para-rectal and intermesenteric groups The extra-rectal glands involved were the right para-aortic and right common iliac glands, the latter presumably an example of retrograde spread. In the remaining cases, 6 centimetres or less from the anus, the glands involved were the hypogastric, common iliac, obturator, promontory and, in one case of squamous carcinoma, the inguinal glands. Deddish cites no case of a rectal growth with extra-rectal lymph gland involvement without involved glands in the para-rectal tissues or inferior mesenteric chain, yet such can occur: a low rectal growth may give rise to secondaries in the lateral pelvic lymph glands before they can be demonstrated in the para-rectal glands (Fig. 44) and certainly before the upward lymphatic path is blocked by growth.

No evidence has been produced to minimize the importance of the upward lymphatic spread in rectal cancer. The removal of the para-aortic glands from the duodenum



downwards has shown metastases in glands which would otherwise have been left and this high dissection is advocated by some as a routine procedure whatever the operation for the removal of the growth. Ligation of the inferior mesenteric artery immediately below the left colic or the first sigmoid artery is generally performed in a combined excision* and by some surgeons at its origin from the aorta. Grinnell (1950) found evidence suggesting that many excisions for large bowel growths were inadequate for [illegible]
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Venous spread

Dukes (1944) found that 17 per cent of rectal growths excised showed involvement of the adjacent veins and that cancer cells could grow down the lumen of a vein in a [illegible]

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* The term "combined excision" indicates an operation performed by a combination of the abdominal and perineal routes. The method used may be abdomino-perineal, perineo-abdominal, or the synchronous combined excision

reflection. The local recurrence rate in the same group (C cases) was 23 per cent for low and only 3·6 per cent for high growths. Waugh and Kirklin (1949) found similar results, the best prognosis being for growths more than 11 centimetres from the anus. Guernsey, Waugh and Dockerty (1951), reviewing 210 dissected specimens removed by abdomino-perineal excision, again confirmed these findings as regards prognosis, but found no evidence of lateral spread in their material though they, like others, attributed the worse prognosis in low growths to increased lateral spread. In fact, if lateral spread was the cause of the worse prognosis in low rectal growths there was no evidence in their
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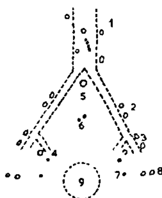


FIG. 43—Lymph glands outside the para-rectal and inferior mesenteric groups which may be involved in rectal cancer; 1, para-aortic; 2, common iliac, 3, external iliac; 4, internal iliac or hypogastric, 5, sacral promontory; 6, mid-sacral; 7, obturator; 8, inguinal; 9, lymphatic drainage of prostate, vesicles and cervix.

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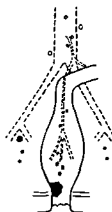
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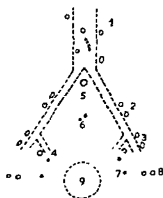


Fig. 43.—Lymph glands outside the para-rectal and inferior mesenteric groups which may be involved in rectal cancer; 1, para-aortic; 2, common iliac, 3, external iliac; 4, internal iliac or hypogastric; 5, sacral promontory; 6, mid-sacral; 7, obturator; 8, inguinal; 9, lymphatic drainage of prostate, vesicles and cervix.

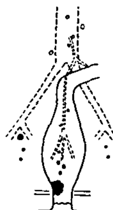
lymphatic drainage system. Villemin, Huard and Montagne (1925) showed that the lymph flow from the upper rectum is upwards, while that from the lower rectum is ... reported by Sauer and ... hatic ... of the peritoneal reflection and some 3–4 inches (8–10 centimetres) from the anal margin.

Morgan (1950) points out the intimate relationship of the lower rectum to the pubococcygeus portion of the levator ani and the pelvic fascia and that the lymphatics of these structures, apart from the lateral ligaments, offer a choice of lateral spread. This contention is a sound one though the published evidence of lateral spread removed at operation has been obtained more frequently by clearing the side ... of the lateral rectal ligaments close to the pelvic ... muscles.

... ents having residual rectal cancer after abdomino-perineal excision, 50 per cent had lesions in structures within the pelvis while the remainder showed secondaries in the liver, lungs, brain, skeleton and subcutaneous areas. He considered that involvement of the obturator and hypogastric lymph glands, and spread to those in the inguinal region, was much more common than is generally recognized (Fig. 43). For annular, deeply ulcerated growths or those ... reflection, he and ... possible ... excision of other pelvic structures in contact with the growth ... uterus,

vagina and seminal vesicles. In a series of 25 cases having abdomino-pelvic lymph gland dissections (para-aortic, sacral promontory, iliac, hypogastric and obturator) 24 per cent showed metastases in glands other than those in the para-rectal and intermesenteric groups, *the usual lymphatic glands removed by the abdomino-perineal* operation. His results are interesting In only one case was the primary growth above 6 centimetres from the anus. Here it was 17·5 centimetres up and a C case as regards the glands in the para-rectal and intermesenteric groups. The extra-rectal glands involved were the right para-aortic and right common iliac glands, the latter presumably an example of retrograde spread In the remaining cases, 6 centimetres or less from the anus, the glands involved were the hypogastric, common iliac, obturator, promontory and, in one case of squamous carcinoma, the inguinal glands. Deddish cites no case of a rectal growth with extra-rectal lymph gland involvement without involved glands in the para-rectal tissues or inferior mesenteric chain, yet such can occur: a low rectal growth may give rise to secondaries in the lateral pelvic lymph glands before they can be demonstrated in the para-rectal glands (Fig. 44) and certainly before the upward lymphatic path is blocked by growth.

No evidence has been produced to minimize the importance of the upward lymphatic spread in rectal cancer. The removal of the para-aortic glands from the duodenum



Fi [illegible]

downwards has shown metastases in glands which would otherwise have been left and this high dissection is advocated by some as a routine procedure whatever the operation for the removal of the growth. Ligation of the inferior mesenteric artery immediately below the left colic or the first sigmoid artery is generally performed in a combined excision* and by some surgeons at its origin from the aorta Grinnell (1950) *found evidence suggesting that many excisions for large bowel growths were inadequate* for the resection of the lymphatic field and in abdomino-perineal excisions, and suggested that the inferior mesenteric artery should be ligated at its origin and the terminal colostomy made in the transverse or descending colon.

Venous spread

Dukes (1944) found that 17 per cent of rectal growths excised showed involvement of the adjacent veins and that cancer cells could grow down the lumen of a vein in a retrograde manner, appearing sometimes as a nodule of cancer in the mucosa below a growth. While this is probably uncommon, it is an additional reason for removing a margin of healthy bowel below a growth. Sunderland (1949) and Grinnell (1950) both found an even higher incidence of venous involvement (27 6 per cent and 36 per cent respectively).

* The term "combined excision" indicates an operation performed by a combination of the abdominal and perineal routes The method used may be abdomino-perineal, perineo-abdominal, or the synchronous combined excision

It is generally agreed that the frequency of gross or microscopic venous involvement increases with the malignancy of the growth and the penetration of the bowel wall, and is more often found in those cases with lymph gland involvement. Sunderland found in Grade III cancers that the 5-year survival rate was only 28·6 per cent when there was venous involvement, but 73·1 per cent when this could not be demonstrated. Its frequency relative to the site of the growth is interesting, for it was present in 42·6 per cent of those within 6 centimetres of the anus, in 22·2 per cent between 6 and 12 centimetres and in only 3·5 per cent of those more than 13 centimetres from the anus.

The spread of rectal cancer to adjacent organs

A low rectal growth may involve the prostate, vesicles and bladder base, the vagina, ureters and sacrum. Above the peritoneal reflection the bladder, uterus, broad [illegible] tion of the lymphatic field. It has also encouraged surgeons to adopt a more radical attitude in the resection of other organs which might be involved by a rectal growth. The complete removal of the posterior vaginal wall for anterior rectal growths below the peritoneal reflection, while more radical, simplifies a combined excision. In the male, the removal of the vesicles and the posterior surface of the prostate can be performed for an infiltrating growth though it does increase the severity of the operation. The most serious problem arises when the bladder is involved. When the growth is above the peritoneal reflection and the degree of bladder involvement is slight, a partial cystectomy may be sufficient. If, however, the bladder base is involved by a low growth, radical surgery requires the removal of all the pelvic viscera, implantation of both ureters into the bowel above the colostomy and a dissection of the abdomino-pelvic lymph glands. The name of Brunschwig (1948) is associated with this operation, which has been performed more frequently for advanced carcinoma of the cervix. Such radical procedures may sometimes be necessary for a high rectal growth: here the removal of the levator ani muscles may not be considered a necessity, and restoration of bowel continuity a possibility. While the plight of a patient dying with a recto-vesical fistula is often pitiful, a "wet" colostomy, even with a Rutzen bag, is a serious hardship, and one which many surgeons feel to be unjustifiable save in few cases, in view of the very uncertain post-operative prognosis.

The mucosa in rectal cancer

[illegible] condition there is [illegible] not purely a local change but the first area of a pre-cancerous [illegible] ome malignant. The frequency with which double carcinomas are found in operations for rectal and colonic growths; the almost inevitable association of small adenomas in the neighbourhood of a rectal cancer; and the post-operative appearance of a fresh primary growth elsewhere in the large bowel after a growth resection, in the rectal [illegible] in the blind sigmoid [illegible] ised on statistics, that [illegible] rather than less, likely [illegible] mucosa is obviously impractical in cases of colonic and rectal cancer, [illegible] y be necessary in multiple adenomatosis, but the rectum is that part of the large bowel most prone to malignant change, and to leave part of the rectal mucosa behind after an operation for rectal cancer must obviously expose the patient to the risk of a fresh primary growth.

The risk will be increased if adenomas are present in the residuum of rectum remaining.

Some of this pathological survey may appear redundant or hardly germane to restorative resection of the rectum, but no operation can be selected for a particular case unless its advantages and disadvantages are borne in mind.

ESSENTIAL PATHOLOGICAL REQUIREMENTS

Essential pathological requirements for the success of restorative resection in carcinoma of the rectum are as follows.

(1) The bowel must be divided 2½ inches below a growth to avoid the risk of retrograde lymphatic and venous spread.

(2) The lymphatic drainage system of the rectum must be removed at its highest practical level by ligation of the inferior mesenteric artery as for an abdomino-perineal or other type of combined excision.

(3) Growths below the peritoneal reflection are more prone to lateral spread and require the removal of the pelvic cellular tissue and the lymph glands on the side wall of the pelvis. It is true that in a thin subject with a wide pelvis this can be performed in an abdominal restorative resection, but the same cannot be said for the potentially involved lymphatic paths. These can best be removed *en masse* by the complete removal of the ischio-rectal fat and levatores ani muscles. In an obese subject with a narrow pelvis a pelvic clearance is difficult enough in a combined operation and cannot be properly performed in a restorative resection. Further, local recurrence in the pelvis is much more common in low rectal growths, even after a combined excision, and their recurrence after a restorative resection may involve the bowel again Pathologically, restorative operations are unsuitable for growths below the peritoneal reflection.

(4) An advanced growth, whatever its site, is more prone to extra-rectal spread and should be treated by the widest possible excision as in a combined operation.

(5) It has been suggested that when histology shows an anaplastic growth a combined excision should always be performed If the growth is small and in a suitable site, I do not personally regard this as a contra-indication though the prognosis is necessarily worse.

(6) The presence of numerous adenomas need not necessarily contra-indicate a restorative operation, for careful pre-operative and post-operative treatment may control them. With open methods of anastomosis the surgeon can both see and treat any adenomas in the anastomotic region at the time of resection.

THE MECHANISM OF ANAL CONTINENCE

It has always been assumed that perfect continence required an intact ano-rectal ring and lining to the ano-rectal canal. The work of Gaston (1948) and of Goligher (1951) has done much to confirm this. Not only should the ano-rectal ring and ano-rectal mucosa remain intact after a restorative operation, but for the proper perception of flatus and faeces some part of the rectal ampulla is necessary Goligher suggests a minimum ano-rectal stump of 6 centimetres The majority of restorative operations fulfil these requirements, though those of Babcock (1932) and Bacon (1945) rely on the external sphincter for continence. While they have the undoubted advantage of the complete (Bacon) or almost complete (Babcock) removal of all mucous membrane, surgeons in Great Britain have not been fortunate in their experience of these operations, and incontinence appears to have been the rule rather than the exception. Bacon claims a high degree of continence in his results. Through his courtesy I have had the opportunity of examining a patient who had had the operation performed upon her two years before Outwardly the anal canal appeared almost normal. On

examination only part of the external sphincter remained and sigmoid mucous membrane was just within the anal verge. The patient could contract the external sphincter quite efficiently and stated that unless her stools were loose she experienced no leakage. Though uncertain of the difference between flatus and faeces she was aware when she needed to defaecate, and was able to delay the act up to 5 minutes. She felt quite secure at home, but if she had a social engagement outside, would first give herself an enema, like a colostomy washout, and wear a perineal pad. Her condition might be described as a perineal colostomy with some degree of voluntary control. This patient was very satisfied with the result and would certainly not have changed for an abdominal colostomy.

THE SIGMOID COLON

A restorative resection requires the anastomosis of the sigmoid to the rectal stump, and its length, its mobility and its vascular supply are of importance. A long and mobile colon is of great assistance, a short bowel or diverticulitis may render the operation impossible. A pre-operative estimate of the length and condition of the sigmoid may be obtained by a barium enema, but until the iliac and pelvic colon have been mobilized at operation it is not possible to estimate the depth to which the meso-sigmoid will allow the bowel to descend. The lowest hanging part of the sigmoid loop is usually that part supplied by the first sigmoid artery. It is usual to ligate and divide the inferior mesenteric artery immediately below the origin of this branch. If the meso-sigmoid is divided just distal and parallel to the first sigmoid artery up to the bowel, the sigmoid at this point will frequently be sufficiently long to permit an anastomosis, and will retain a direct blood supply from the first sigmoid artery.

If additional length is required the incision in the meso-sigmoid starts in the same manner but on reaching the arterial arcade between the first and second sigmoid arteries it proceeds distally, parallel to the bowel. The point of division may be lengthened by two or three inches, and its viability will now depend on the anastomosis between the sigmoid arteries in the meso-sigmoid. In a thin subject the inter-sigmoid arcades are easily visible; in a fat meso-colon they may be hardly palpable, but may be recognized by the accompanying veins.

The length of the first sigmoid artery may prevent sufficient descent of the sigmoid and it may itself require division. Goligher (1949) found the most common origin of this vessel to be conjointly with the left colic from the inferior mesenteric. In such a case, following division of the inferior mesenteric artery at the usual site, additional sigmoid may be obtained by dividing the first sigmoid artery immediately below its origin. If it has a separate origin from the inferior mesenteric artery, this vessel may be divided between the first sigmoid and the left colic branches. The sigmoid stump will now depend on the descending branch of the left colic and its anastomosis with the first sigmoid artery.

In addition to these measures the length of the sigmoid will be increased by full mobilization of the descending and iliac colon. The transverse colon and splenic flexure have occasionally been anastomosed to the rectal stump. There must be certainty of the viability of the sigmoid at the point chosen for anastomosis, and this may be verified by arterial pulsation, arterial bleeding from the divided meso-sigmoid, and bowel, and by the actual appearance of the bowel itself. If there is doubt, or the anastomosis can be performed only under tension, a combined operation should be undertaken.

A considerably longer sigmoid is necessary for those operations in which the anastomosis is made in the perineum than when it is made in the pelvis. In the case of a short sigmoid, attempts to provide a sigmoid stump of adequate length may lead to the retention of sigmoid and meso-sigmoid in close proximity to the upward lymphatic drainage system of the rectum and this should be avoided.

CASES SUITABLE FOR RADICAL RESTORATIVE RESECTION: FREQUENCY

This subject has been discussed by various writers (Bacon, 1945; d'Allaines, 1946 and 1950; Muir, 1948; Morgan, 1950; and Lloyd-Davies, 1950). It is unlikely that the site of rectal cancer varies greatly throughout the world, yet the published figures from those centres in which this operation is employed show a considerable variation in the frequency with which suitable cases arise. This may be due not only to varying criteria in selection but in what actually constitutes anatomically a rectal growth. In Great Britain this is usually regarded as one below the sacral promontory while those at promontory level are recto-sigmoid The criteria for radical resection have been well set out by Morgan (1950) and Lloyd-Davies (1950) Pathology, anatomy and function combine towards this selection

(1) The lower edge of the growth must be not less than 10 centimetres from the anus and 2 inches above the lowest peritoneal reflection in order to permit its proper removal and the retention of full function.

(2) Advanced growths with extra-rectal spread are unsuitable.

(3) Obese subjects with a narrow pelvis render the operation difficult or impossible.

(4) The sigmoid colon must be sufficiently free and vascularized after mobilization to permit an anastomosis without tension.

(5) The rectal stump to be retained should be free from adenomas or any adenomas present should have been removed.

Growths discovered on sigmoidoscopy or just palpable at the tip of the finger in a subject permitting full digital exploration are usually suitable. The prolapse of a high growth may be misleading, for the rectum is not a straight tube : a growth may be farther from the anus than at first appears. Growths palpable 2–3 inches above the cervix or vesicles may appear suitable but a final decision can be made only at laparotomy.

It is probable that those surgeons in Great Britain who commonly employ this operation consider not more than 20–25 per cent of cases to be suitable for radical restorative resection. It is right to point out that some, whose opinion and experience command the greatest respect, regard it as unjustifiable owing to the possible increased risk of recurrence on the principle that the whole of a cancerous organ should be removed.

Palliative restorative resection

[illegible] combined resection.

The use of colostomy

A preliminary transverse colostomy allows a resection to be performed on a non-functioning and, through proper lavage, an almost sterile bowel It has, however, the disadvantage of prolonging hospitalization and adding two additional anaesthetics. It is certainly indicated if obstructive signs are marked.

A transverse colostomy performed at the time of resection has much to commend it and should always be performed if bowel preparation is found to be inadequate or the anastomosis difficult

Modern drugs and antibiotics have lessened the risks of bowel anastomosis, and at

the present time many surgeons perform this operation without a colostomy. Published figures suggest that in some centres there has been little difference in the mortality rate.

I have a personal bias in favour of colostomy, either as a preliminary or at the time of resection, but this view is not widely held and may be unjustifiable. It cannot be denied that proximal colostomy does lessen the risks of an anastomosis, and for that reason I still consider it advisable.

Pre-operative treatment

The pre-operative treatment of these cases is essentially that for colonic surgery and has already been described in that section.

OPERATIVE METHODS

A radical resection of the rectum with preservation of the sphincter may be performed from the abdomen alone, this requiring an anastomosis in the depths of the pelvis, or the abdominal mobilization may be combined with a perineal anastomosis. This may be performed above the levator ani muscles, aided by their partial division, or outside the anal canal. Of these various methods abdominal resection and anastomosis, or, as it is commonly called, anterior resection, is that generally employed, but mention will be made of some of the other procedures.

Abdomino-sacral resection

The sigmoid colon and rectum are mobilized as for an abdomino-perineal excision, the meso-sigmoid being divided in such a manner as to ensure an adequate length of bowel with a good blood supply. The sigmoid is tucked down into the pelvis and the pelvic peritoneum sutured around it. A perineal incision is now made, the coccyx removed, part of the levator ani divided in the midline, the rectum and sigmoid drawn into the wound and the resection anastomosis completed. The advantage claimed for this operation is that it does permit the division of the rectum at a very low level. Troublesome fistula and sepsis are stated to be more common after this operation and it is not in general use.

Abdomino-anal resection

After the abdominal mobilization has been completed the rectum is divided below a clamp just above the ano-rectal ring and the small ano-rectal stump everted into the [illegible] the growth [illegible] anastomosis completed, in the perineum. This operation is best performed by the surgeons using the Trendelenburg-lithotomy position described by Lloyd-Davies (1939). It enables the anastomosis to be made at a low level but it does require a long sigmoid colon, it has sometimes been followed by temporary incontinence, and it is not so generally useful as an anterior resection. It is advised by Lloyd-Davies (1950) as a palliative operation for cases with hepatic metastases where the growth is too low to allow an intra-abdominal anastomosis.

"Pull-through" resection

After abdominal mobilization the rectum is made to prolapse through a dilated anus, a circular incision is made through the wall about 1 inch above the muco-cutaneous junction, and the rectum, the growth and sigmoid are pulled through into the perineum. The sigmoid is divided at a suitable site and the anastomosis completed.

This operation again requires a long sigmoid and has the disadvantage that a bulky growth may be torn in the effort to manipulate it through the anal sphincter. It has no advantage over the abdomino-anal operation and should be replaced by it.

Proctosigmoidectomy (Bacon)

After the abdominal mobilization the abdomen is closed without suturing the pelvic peritoneum but with a steel sump drain down to the pouch of Douglas. With the patient in the lithotomy position a circular incision is now made at the mucocutaneous line and the rectal mucosa dissected upwards. An incision is now made through the external sphincter in the midline posteriorly and through this space the levator ani muscles are divided from their attachment to the rectum. The rectum, growth and sigmoid are now pulled through the enlarged anus and the sigmoid is divided 2 inches distal to the anus, a tube being left in the bowel. The sigmoid stump is trimmed two weeks later. Some mention has already been made of this operation, the details of which may be obtained from the original papers. It does remove all rectal mucosa and it does provide in the author's hands a varying degree of continence. Its disadvantage is that it cannot, according to our knowledge, provide full and normal continence: the ischio-rectal fat is not removed and the removal of the levator ani muscles is less radical than in a combined excision. It is seldom used in Great Britain.

Anterior resection

The first steps are performed in the same manner as the abdominal part of a combined excision.

The descending iliac and sigmoid parts of the colon are fully mobilized by division of any peritoneal folds on their outer side and the inferior mesenteric artery is ligated and divided below the first sigmoid branch. The rectum must now be mobilized.

Intraperitoneal anastomosis

If the site of the growth is at the recto-sigmoid junction it is frequently possible to divide the bowel 3 inches below the growth and yet perform an intraperitoneal anastomosis. In these circumstances the peritoneal incisions on either side of the rectum need not be joined across the pouch of Douglas, the lateral ligaments need not be completely divided, nor the rectum fully mobilized from the sacral hollow. The condition of the sigmoid colon is now reviewed and a decision made as to its suitability for anastomosis to the rectal stump. If the length and vascularity of the sigmoid is satisfactory the meso-rectum is divided 2½ inches below the growth and will require ligation. The rectal stump is now nourished by the middle and inferior haemorrhoidal vessels, but its blood supply is frequently sufficient to cause considerable arterial bleeding. A clamp is applied across the rectum and an assistant working from the perineum dilates the anus and washes out the rectal stump below the clamp. Lloyd-Davies (1950) advises a sodium bicarbonate solution and 1 : 500 perchloride of mercury to reduce the danger of cancer cell implantation in the divided bowel. The rectum is now divided below the clamp, the sigmoid divided obliquely at the selected site and the anastomosis performed. The sigmoid lies best if its mesenteric border is sutured to the right side of the divided rectum, as this also applies its peritoneal coat [illegible]

[illegible] quently for growths of the distal sigmoid when a wedge resection of the meso-sigmoid may not efficiently resect the lymphatic drainage area because it fails to remove the chain of glands along the inferior mesenteric artery.

Extraperitoneal anastomosis

If the growth is in the rectum proper, below the promontory, yet a sufficient distance above the peritoneal reflection to make restorative resection practical, the fullest mobilization must be performed. After the peritoneal division, the rectum is stripped forward from the sacral hollow, the fatty and lymphatic tissues are stripped inwards from the ureteric line, the lateral ligaments divided close to the side wall of the pelvis and the dissection carried down to the levator ani laterally, posteriorly and anteriorly between the rectum and the vesicles, prostate or vagina. This dissection is best performed in a thin woman with a wide pelvis. It may have to be performed indifferently in an obese man. It is complete when the bands passing from the longitudinal muscle fibres of the rectum to the ilio-coccygeus portion of the levator ani can be felt laterally and posteriorly (Fig. 45). These posterior bands join the ilio-recto-coccygeus muscle (Courtney, 1950), and if this is divided the rectum can be felt to strip still farther forward.

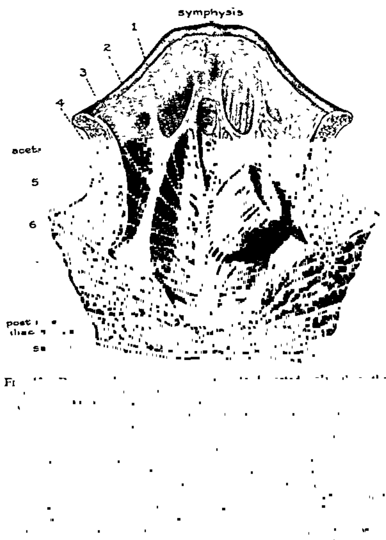
The dissection will lose much of its purpose if any of the para-rectal fat is left behind in the pelvis. A clamp is now applied across the rectum leaving sufficient bowel below it for the anastomosis and the rectal stump is cleansed from the perineum. The clamp used may be right-angled or a Wertheim's hysterectomy clamp, which takes up less room in the pelvis. A suitable site is selected on the sigmoid and the meso-sigmoid divided to give the required length. The sigmoid is cut obliquely and if its lumen appears unduly narrow it may be enlarged by extending the incision on the antimesenteric border. No clamp should be used on the end of the sigmoid. With the uterus and vagina, prostate and vesicles retracted forwards the rectum is pulled upwards by the clamp, a gauze swab tucked in front of the sacro-coccygeal region, and an incision made across the anterior rectal wall below the clamp (Fig. 46*a*). The lower cut edge is picked up right and left by two "cobbling" sutures which are held long and [illegible] (Fig. 46*b*). The [illegible] *er holding* [illegible] ood supply [illegible] e posterior vaginal wall, the prostate and the pubo-rectalis fibres which closely invest it. Any bleeding points in the para-rectal fat are ligated.

The distal end of the sigmoid is now anastomosed to the rectal stump, starting with the mesenteric border of the sigmoid to the right side of the divided rectum. A row of mattress sutures is first placed turning in the mucous membrane for the posterior part of the anastomosis. These stitches may be placed and tied one by one or they may all [illegible]

now starts in the middle of the posterior line of the anastomosis and [illegible] the left side inverting the mucosa of rectum to end in the midline anteriorly. A similar [illegible]

tissues and the sigmoid is also sutured to the posterior [illegible] around the anastomosis, the pelvic [illegible]. Many surgeons prefer [illegible] toneal route. I personally prefer drainage to the sacral hollow by a stab drain beside the coccyx, or by the actual removal of the coccyx. This latter gives excellent drainage but leaves a more painful wound. It is my practice to use only catgut sutures. If silk is used it should not involve the mucosa since it may cause persistent granulations and increased scarring.

This operation can be long and tedious. It requires a good light, good retractors (Fig. 47), the correct position of the patient, and able assistance. It is easier if the



Fi

courtesy of the Amer J Surg)

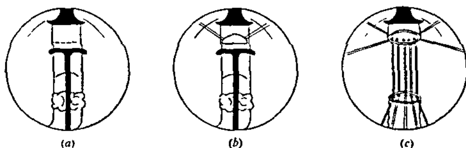


Fig 46 —Extraperitoneal anastomosis (a) Clamp and retractor applied The proposed line of incision in anterior rectal wall is shown (b) Anterior rectal wall divided. Two cobbling stay sutures are inserted. (c) Insertion of posterior layer of inverting mattress sutures with sigmoid end outside pelvis. After all have been inserted the bowel is slipped down the sutures to the rectal stump, and the sutures are then tied. (*By courtesy of Brit med J.*)

dissection is not carried to such a low level, and this is not always necessary, but a sufficient length of [illegible]

[illegible] glands may also be carried out.

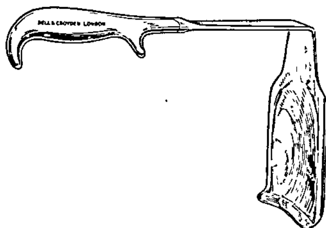


FIG. 47—Deep pelvic retractor. The hollowed blade and flange assist in holding the pelvic viscera upwards and forwards.

RESULTS

Mortality rate

It would seem to be the general opinion of those surgeons employing these operations that the mortality rate is lower than for combined excision (Morgan 1950; Lloyd-Davies, 1950). Operative time may be longer but, particularly when there is no perineal phase, shock is less. In a personal series of 168 operations for rectal cancer during the past six years, 93 patients were subjected to a combined excision with 5 deaths and 42 patients to a restorative resection without mortality.

Total cases	168
Abdomino-perineal or other form of combined excision	93
Anterior resection	38
[illegible]	4
[illegible]	1
[illegible]	3
Inoperable	29

Operability rate (resectability) . 82 per cent.

Mortality	5 cases; all following combined excision	
	Pulmonary embolus	2
	Renal failure and senility	1
	Renal failure and broncho-pneumonia	1
	Paralytic ileus	1

Complications

Apart from those common to any major abdominal operation pelvic infection, fistulae, stricture and incontinence are all possible complications.

Pelvic infection

Serious pelvic sepsis is much less likely in the presence of a colostomy: its appearance where this has been omitted is an indication for an emergency colostomy. It may be

associated with necrosis and separation of part or even the whole of the anastomotic line through deficient vascular supply to the sigmoid "end", or the rectal stump. Three cases of fistula occurred in this series, one into the vagina and two into the pre-sacral space. Lloyd-Davies (1950) estimates the incidence of sepsis in association with the anastomosis as 1 : 10.

Stricture

Initially the anastomotic ring is always smaller than the rectal ampulla since it is the junction with the sigmoid. In the majority of cases it soon dilates and it may be



FIG 48.—Barium enema showing stricture at anastomotic site after anterior resection. The stricture was symptomless.

difficult to detect any narrowing some years later. It may persist as a narrow fibrous ring, well demonstrated by a barium enema (Fig. 48) though I have personally seen no case requiring dilatation.

Incontinence

One patient subjected to an abdominal anal resection suffered some degree of incontinence for a few weeks but rapidly regained complete control There was no case of incontinence following anterior resection. Goligher (1951) in reviewing 171 patients from St. Mark's Hospital, treated by restorative resection, found no case of incontinence in 120 cases submitted to anterior resection, some impairment of continence in 20–25 per cent of those submitted to abdominal-anal operations and incontinence in all 5 patients undergoing a Babcock-Bacon type of resection.

The mechanism of continence has already been discussed in relation to restorative resections and there would appear to be no reason why this complication should occur after an anterior resection. The majority of these patients find it necessary to defaecate

more frequently than they did previously, and an attack of diarrhoea, tolerable in a normal person, becomes embarrassing, since they have lost part of their faecal reservoir. On post-operative rectal examination a completely empty rectum is found less commonly than in normal patients: the "emptying mechanism" has lost a little of its efficiency though I have never heard any complaint of this condition.

SURVIVAL RATE

Dixon (1948) in a large series obtained a 5-year survival rate of 67·7 per cent where *restorative resection* was employed, but only 44·8 per cent with a combined excision, and the 5-year survival rate for all cases of rectal cancer treated by combined excision is seldom given as over 50 per cent. Figures such as these, however, give no fair assessment of the merits or demerits of restorative resection, for it is recognized that the prognosis in a high rectal growth, where restorative resection might be employed, is considerably better than in a low growth. It is more important to judge the operation by its failures if such failures could not have occurred had a combined excision been performed, and to set against this the advantage of avoiding a permanent colostomy.

Local recurrence in the recto-sigmoid anastomosis

The risk in retaining part of the rectal mucosa following an operation for rectal cancer has already been mentioned and a number of cases have been reported in which a further growth has developed in the rectal stump or in and around the anastomotic line of a restorative resection. Local recurrence can take place in the soft tissues of the pelvis following a combined excision and does so in a considerable proportion of cases. Local recurrence may take place in exactly the same manner after a restorative resection and may subsequently invade the anastomotic line of the bowel. Such an event might indicate the operation to be ill-chosen, but it would not be an inherent defect in the type of operation since combined excision might have done no more. It is more disturbing if local recurrence develops at the anastomotic site when all pathological evidence is against an extra-rectal recurrence.

Such cases have been described (Lloyd-Davies, 1948; Muir, 1948) and are still occurring.

There would seem to be three possible explanations when local recurrence develops at the anastomotic site.

(a) It is due to residual cancer cells remaining in the extra-rectal soft tissues and subsequently involving the anastomotic line, to retrograde lymphatic and venous spread, and in general to an operation which has not been sufficiently radical.

(b) The stimulus of regeneration and repair occurring at the anastomotic side is sufficient in a pre-cancerous bowel to start a fresh growth.

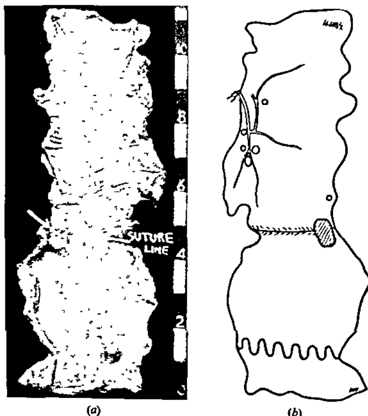
(c) Cancer cells lying in the bowel lumen are implanted on the suture line at the time of operation. This implantation and growth of cancer cells on granulation tissue is not uncommon and has been seen on the surface of an anal fissure below a rectal growth Lloyd-Davies (1950) attaches considerable importance to this possibility.

Long, Mayo, Dockerty and Judd (1950) analysed 30 cases of recurrent cancer at or near the anastomotic site in the large bowel where sufficient material was present to enable a proper pathological opinion to be given. Of the 30 cases they regarded 21 as representing actual persistence of the original growth and 9 as new and independent tumours.

In this personal series of 42 restorative resections there were 5 cases of local recurrence involving the anastomotic line. One of these had been a palliative operation, performed on an elderly lady aged 81 years. The remaining 4 cases had all undergone

radical resections and when recurrence developed were all subjected to combined excisions. In these circumstances this is not an easy operation and may require removal of the lower part of the sacrum to which the anastomotic ring is firmly adherent.

Case I.—This case has already been described (Muir, 1948). A woman aged 59 years had a restorative resection performed for a high rectal growth in June, 1946. The specimen showed that an adequate length of bowel below the growth had been removed. All lymph glands examined below the growth appeared free but metastases were present in a gland at the highest level. Two years later a polypoid growth developed at the anastomotic line and an abdomino-perineal excision was performed (Fig. 49) I am indebted to Dr. Cuthbert Dukes for the following report:



(*a*) (*b*)

Fig 49.—(*a*) Specimen obtained by abdomino-perineal resection for recurrent carcinoma two years after restorative resection (Case I) (*b*) Pathologist's drawing of specimen.

One year after the combined excision this patient developed signs of recurrence in the pelvis. These developed slowly but she died in March 1951, five years after the restorative resection, with recurrence in the pelvis, mesentery and liver.

Case II.—A man aged 58 years underwent a restorative resection in 1947 for a small growth 10 centimetres from the anus. Subsequent histology showed this to be an A case. Two years later he developed a small granulating area in the anastomotic line posteriorly. This was kept under close observation and three successive biopsies showed no evidence of malignancy. Almost 1 year after the first appearance of this granulating area the fourth biopsy showed a carcinoma and a combined excision was performed The specimen showed a raised ulcerated area 1·5 centimetres in diameter which histologically was a well-differentiated carcinoma. There was much fibrosis around the anastomosis but no evidence of extra-rectal spread, and none of the glands examined contained growth This patient is still alive, well and free from recurrence 4½ years after his restorative resection, and one year after the combined excision.

Case III.—A man aged 59 years with a growth 20 centimetres from the anus underwent a restorative resection in October 1948. The growth proved to be a C case on histological examination. Five months later a recurrence had taken place in the anastomotic line and a combined excision was performed. The specimen showed an ulcerated nodule 3 centimetres diameter on the suture line which histologically was more highly differentiated than the primary growth No growth was found in the extra-rectal tissues or in the glands Fourteen months after the combined excision the patient developed a recurrence in the sacrum and died 3 years after the first operation, with secondaries in the liver.

Case IV—A woman aged 65 years had a restorative resection performed in April 1947, for a large papilliferous growth 8 centimetres from the anus The margin of healthy bowel excised below the growth was known to be insufficient but it was hoped that the growth was an A case It proved, however, to be a B case. Two years later she developed a large recurrence at the anastomotic line and a recto-vaginal fistula, for which a combined excision was performed with removal of the posterior vaginal wall. The specimen showed growth invading the vagina and extra-rectal tissues. There were no glandular metastases and histologically the growth was highly differentiated as was the primary tumour. This patient is alive and well, and free from recurrence 4½ years after the restorative resection and 2½ years after the combined excision.

It is reasonable to suppose that the recurrence in Case IV was due to an ineffective resection, and that growth remaining in the extra-rectal tissues subsequently invaded the anastomotic line. We do not know how long cancer cells may remain dormant when implanted in an anastomosis, but the rapidity of recurrence in Case III, where the height of the growth made adequate resection certain, suggests implantation. The recurrence in Case I might be either a fresh primary tumour or an implant, and Case II is suggestive of a fresh growth developing in an ulcerating area in precancerous bowel. Whatever the ultimate prognosis, the initial recurrence in these four cases could have been avoided by a combined excision.

There are no other *known* cases of local recurrence in this series.

Of the remaining 37 cases the resection was palliative in 3. One patient survived with known hepatic metastases 18 months after operation, while both the remaining patients died one year later. In the remaining 34 cases 3 died at intervals of 3 years, 2 years and 1 year (sudden death aged 70 years, hepatic and sacral metastases, and pulmonary tuberculosis respectively); 2 patients, though alive, are known to have hepatic metastases at intervals of 4 years and 18 months; 1 patient has undergone a resection of an advanced carcinoma of the splenic flexure 3 years after the restorative resection and has small hepatic metastases; 2 patients are untraced though known to have been well after 1 and 2 years; and 26 patients are alive and believed free from recurrence at intervals of from 1 to 6 years. The oldest patient, now aged 87 years, underwent restorative resection 3 years ago.

Until a large series of these cases with careful histological examination can be

compared with cases of combined excision we shall learn more from operative failures than successes.

CONCLUSION

In the treatment of rectal cancer combined excision must remain the operation of choice for the majority of cases. It must be allowed that the prognosis after combined excision will always remain slightly better than after a restorative resection, however well chosen and performed, for the risks of local intra-rectal recurrence are present. This does not mean that the operation is unjustified. There are few surgeons who would insist on excising the complete rectum for a carcinoma of the sigmoid loop though such a procedure might well improve the post-operative prognosis. Though all reviews have shown that the great majority of patients adapt themselves well to a permanent colostomy, it remains a hardship. Restorative resection is an excellent operation but it will be justified only if it is confined to carefully selected cases and if such cases are subjected to the most careful and continued post-operative observation.

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STOMACH—VASCULAR SUPPLY OF IN RELATION TO GASTRIC ULCER

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The numerous factors which appear to be concerned in the production of gastric ulceration are indications of the lack of certainty which surrounds our knowledge of the cause of this common disease. It is almost 100 years since Virchow first gave prominence to the suggestion that aseptic occlusion of vessels in the stomach produced an area of ischaemic mucosa, which was then digested by the gastric juice with the formation of an ulcer. During this century the vascular basis of gastric ulceration has had many proponents, most of whom have considered the derangement of circulation to be an organic block of vessels in the region of the mucosa or submucosa, whether by thrombosis, embolism or spasm. In general, two main schools of thought have existed: one insisting on occlusion of the mucosal arteries or capillaries as the cause of ischaemic ulceration, the other holding that venous obstruction in the stomach wall led to congestion, cyanosis and stasis, and so to tissue necrosis.

In the present uncertainty there is scope for large differences of interpretation and of opinion, but the simple anatomical and pathological facts, on which hypothesis can be founded, concerning the vessels of the normal stomach wall and of ulcerated areas in a diseased stomach, should by now be incontrovertible. In the hope that these basic facts can be made plain, the vascularization of the stomach and the vessels of acute and chronic gastric ulcers have been re-examined by old and tried methods of anatomy as well as by the new techniques of micro-arteriography. The results are here presented in relation to some of the suggested vascular causes of gastric ulceration.

The methods employed for a study of the vessels in the stomach wall have been fully described by Barlow, Bentley and Walder (1952). Two techniques have been used. The first consists in injecting the vessels of the stomach with radio-opaque substances; the gross specimen is then examined by radiography, and thin slices of the [illegible] 1947, 1951). In this way radio- [illegible] ssels are seen, and an overall [illegible] hes, can be built up. A second valuable method is to inject the arteries and veins of the stomach with gelatin solutions of different colours, after which the specimen is cleared until it is transparent to light; then, by patient dissection under the microscope, the vessels are followed through the stomach wall to their destinations. Some of the stomachs used in this work were obtained *post mortem*, but much of the investigation of vessels of the distal two-thirds of stomach was done on fresh operation specimens removed at the operation of partial gastrectomy for duodenal ulcer.

THE ARTERIAL SIDE OF THE VASCULAR TREE

Occlusion of vessels in the stomach wall by thrombosis, embolism or spasm leading to ischaemic necrosis of the mucosa (Virchow, 1853), was a simple and attractive

explanation of gastric ulceration, and was made the more plausible by description of the mucosal arteries in the stomach wall as end-arteries, by Disse (1904) and Hauser (1926). This view gained general credence, and was not upset by the work of Djörup (1922) who claimed that the branches to the mucosa had widespread anastomotic communications with each other. It was obviously necessary to clarify this issue while tracing the vessels from their origin in the extra-gastric chains to their mucosal terminations.

The extra-gastric chains course along the two curvatures of the stomach, and nothing needs to be added to the standard descriptions in the text-books of anatomy. On the lesser curve the major contribution is made by the left gastric artery which, after the origin of its ascending branch, turns down along the curve of the stomach and usually divides into two main channels, one running on the anterior and the other on the posterior aspect of the lesser curvature, both vessels lying within the limits of the lesser omentum One of these branches joins directly with the small right gastric artery to complete the narrow arterial chain which runs along the upper border of the pylorus and the first part of the duodenum.

The large gastro-epiploic chain of vessels follows the greater curve of the stomach from the lower border of the first part of the duodenum to a point on the greater curve about 5–6 centimetres distal to the lower end of the spleen. More proximal to this, the vasa brevia supply the fundus area of stomach (Fig. 50).

From these two vascular chains branches arise at intervals of about 1 centimetre and pass on to the surface of the stomach. Those from the lesser curve pass obliquely across the stomach towards the pylorus, piercing the muscle coats about 1·5–2·5 centimetres from the line of the curvature The branches from the gastro-epiploic chain penetrate the muscle coats of the stomach about 1 0–1 5 centimetres from the greater curve.

Arrangement of vessels in the anterior and posterior walls of the stomach

As the branches to the stomach traverse the muscle coats they give off many small twigs, and on reaching the submucosa divide, without any loss of size, to form an extensive anastomosing network—the submucous plexus. The plexus lies in the thick layer of connective tissue which intervenes between the muscle coats of the stomach and the glandular layer, and forms a rich network of vessels about 550–650 μ in diameter (in the fresh unfixed specimen), the main limbs of the plexus being further connected by smaller branches of about 300 μ bore, which lie a little deeper in the submucous connective tissue (Figs. 50 and 51).

The plexus has its greatest development in the body of the stomach, but is continuous over the fundus and throughout the pyloric canal. In these two regions the vessels of the plexus are of smaller size than in the body, about 300 μ in diameter in life, corresponding to the smaller cross-anastomotic channels of the submucous plexus in the stomach body.

The presence of this extensive plexus of large vessels in the submucous layer of the stomach explains the extreme vascularity of the stomach wall which is well known to all operating surgeons, and indicates why bleeding is profuse from an unsecured bleeding point in the gastric suture line, or in the base of an ulcer The anastomosis is so free that all the limbs and branches of the plexus are readily filled by injection of either extra-gastric chain at a single point, which helps to make clear how the stomach survives the operation of "gastric ligation", for the few gastric vessels which remain after this operation—at the pylorus, in front of the spleen and at the oesophageal junction—will enable blood to reach and be distributed throughout the submucous plexus of the stomach, and it is to be expected that compensatory dilatation of the feeding arteries will soon restore blood flow to its original volume.

The plexus provides a distributing mechanism for blood throughout the stomach



FIG. 50.—Radiograph of arteries of stomach, showing extra-gastric chains on the two curvatures, branches to stomach, and submucous plexus L.G.E. = Left gastro-epiploic artery. V.B. = Vasa brevia (× 0·4.)

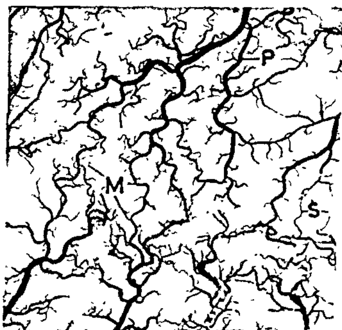


FIG. 51.—Radiograph of vessels of submucous plexus in anterior wall of body of stomach. P = Main communicating channels. S = Smaller communicating channels. M = Arteries for supply of the mucosa. (× 2.)

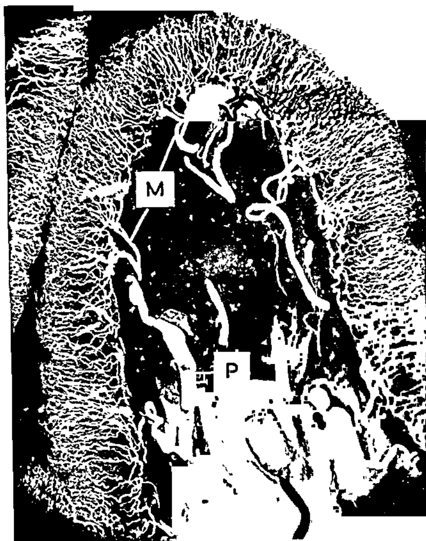


FIG 52.—Radiograph of vessels in fold of mucosa from anterior wall of body of stomach P = Submucous plexus. M = Mucosal arteries. (× 16.)

wall, and from the limbs of the plexus arise large numbers of branches for the supply of the mucosa (Fig. 51). The mucosal branches at their origin are about 200 μ in diameter in the unfixed specimen, and pass obliquely across the submucosa towards the mucous membrane; as each mucosal artery approaches the muscularis mucosae it breaks up into two or three smaller branches which twist and coil round each other, before separating and piercing this thin muscular sheet to reach the glandular tissue (Fig. 52) About 90–120 of these branches are to be found perforating each square centimetre of the muscularis mucosae. Just under this muscle layer the mucosal arteries or their branches are linked by slender anastomosing channels, about 50 μ in size, each with its neighbour, or sometimes with a branch a little distance away (Fig. 53).

On the glandular aspect of the muscularis mucosae the mucosal branches form a network of anastomosing channels, from which the capillary vessels of the mucosa arise (Fig. 54). These vessels have a characteristic and striking arrangement; they consist of leashes of large capillaries about 20 μ in diameter running vertically through the mucosa, and giving rise to extensive capillary branches of smaller size (Figs. 52 and



FIG 53 —Anastomotic branch connecting two adjacent mucosal arteries on under aspect of muscularis mucosae, anterior wall. M = Mucosal arteries. D = Anastomotic branch (× 20.)

60) The capillaries appear almost to fill the substance of the mucosa, and ramify among the glands like the arborizations of a tree, each spread of branches joining at its tips with adjacent capillary twigs, and forming at the surface larger loops surrounding the orifices of the glands.

This pattern of distribution of the mucosal arteries is the same in the fundus, body and pyloric antrum, and although the submucous plexus is composed of larger vessels in the body of the stomach than in the other two parts, there are no differences in the course of the mucosal arteries, or in the number of branches per square centimetre of mucosa, or in the richness of the mucosal vessels, in these different regions of the stomach. The vascular arrangement common to all consists of a rich mucosal supply, which, between its origin from the vascular chains along the two curvatures and its terminations in the mucosa, freely anastomoses at different levels; first, in the submucous plexus of large vessels, then between the mucosal arteries underneath the muscularis mucosae, again on the glandular aspect of that muscle, and finally between the capillary leashes in the mucous membrane. The freely anastomotic nature of the blood supply of the stomach wall is a notable feature. As was indicated by Djørup (1922), there are no anatomical end-arteries. The mucosa lies within a large vascular network made up of anastomosing mucosal arteries and the submucous plexus of large vessels. *So free is the anastomosis on each side of the muscularis mucosae that it* appears very improbable that block of a few mucosal arteries would affect the circulation in any part of the mucous membrane. Thrombosis or embolism of the feeding vessels would need to be extensive over a wide area to render ischaemic a portion of mucosa, and such extensive block must by now have been noted had it occurred. Spasm of vessels is a theoretical conception in disease, often invoked with little or no evidence in its support, but even if spasm of the mucosal arteries should occur it would need to affect considerable numbers of mucosal arteries simultaneously, unless the



FIG 54—Anastomosing network of vessels on glandular aspect of muscularis mucosae. A = Anastomosing branch m m = Muscularis mucosae. V = Mucosal collecting vein. c p. = Capillary branches of mucous membrane Section 200 μ thick. (× 83)

spasmodic closure should involve the mucosal capillaries themselves, when ischaemia of the mucous membrane would naturally follow.

From the anatomical standpoint, the concept of end-arteries in the stomach wall readily blocked by thrombosis, embolism or spasm, is not valid. On the contrary, the extent and freedom of the vascular anastomoses indicate the improbability that localized vascular occlusion will render ischaemic a portion of the mucous membrane.

Arrangement of vessels in the region of the lesser curve

So far, this account has concerned itself with all parts of the stomach except the region of the lesser curve. It has been suggested from time to time that there is a relative vascular deficiency along the lesser curve portion of the stomach, and Reeves (1920), Djorup (1922) and others have described the arterial branches within the lesser curve as more slender, and the anastomotic connexions finer in calibre and fewer in number, than in the adjacent anterior and posterior walls. It is of obvious importance to determine the precise vascular anatomy of the lesser curve region, and to inquire whether special conditions exist which might predispose to local vascular occlusion.

The branches of the right and left gastric arteries destined for the anterior and posterior walls of the stomach pierce the muscle coats 1·5 to 2·5 centimetres from the line of the lesser curve. The tissue along the lesser curve and for about 2 centimetres on either side is supplied by slender branches, about 200 μ in diameter in the fresh specimen, which arise from the lesser curve vascular chain within the edge of the lesser omentum, and which are often connected by anastomotic branches before they pierce the muscle coats to reach the submucosa. They then traverse the submucosa towards the muscularis mucosae without the formation of a submucous plexus (Fig. 55). These fine vessels are the mucosal arteries [illegible]

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membrane (Fig. 56) As they approach the muscularis mucosae they anastomose with

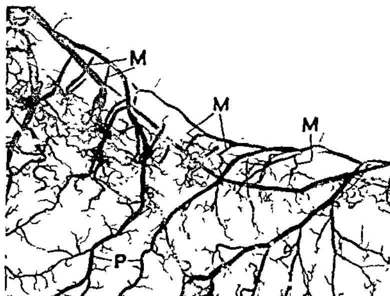


FIG 55.—Radiograph of branches to lesser curve of stomach. P = Branches to submucous plexus of anterior wall. M = Branches going directly to mucosa of lesser curve. (× 1 8.)



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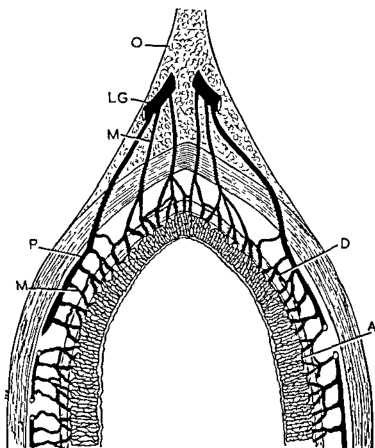


FIG 57.—Arrangement of arteries in anterior and posterior walls, and in lesser curve. P = Submucous plexus M = Mucosal arteries D = Anastomosing branches on under aspect of muscularis mucosae A = Anastomosing branches on glandular aspect of muscularis mucosae L G = Left gastric artery. O = Lesser omentum.

each other, or, where the lesser curve merges with the anterior and posterior walls, with the corresponding mucosal artery from the submucous plexus of those parts (Fig. 56) At this level they divide into smaller branches which twist and coil around each other before penetrating the muscularis mucosae to form a network of vessels on its glandular aspect from which arise leashes of capillaries characteristic of gastric mucous membrane

The lesser curve vessels are thus peculiar in two particulars' first, the mucosal arteries arise outside the stomach, not from a large plexus of vessels in the submucous layer, and second, there is no submucosal plexus of vessels Reeves (1920) and Djørup (1922) had noted that the anastomotic branches in the submucosa of the lesser curve region were finer as compared with other parts of the stomach, but the significance of the observation had not been made clear. The slender anastomosing branches are the usual fine branches which connect the mucosal arteries in all parts of the stomach. The comparison is shown schematically in Fig. 57.

The distribution of the mucosal arteries to the mucosa of the lesser curve is identical with that in other parts. The number of vessels piercing the muscularis mucosae in this region is the same per square centimetre as in the anterior or posterior wall (Fig. 58). The size of the mucosal arteries is the same, their anastomoses with each other on either side of the muscularis mucosae are similar, and the richness of the capillary network and the pattern of vessels within the mucosa are indistinguishable. The

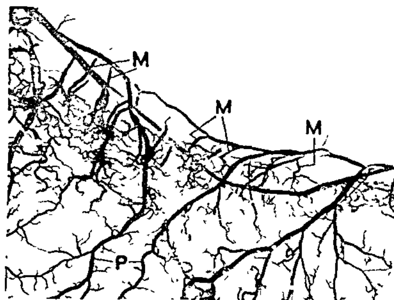


Fig 55.—Radiograph of branches to lesser curve of stomach P = Branches to submucous plexus of anterior wall. M = Branches going directly to mucosa of lesser curve. (× 1 8)



Fig. 56.—A mucosal artery of lesser curve The free cut end (C) is divided at *the point of penetration through muscle coats.* The vessel proceeds directly to its termination without intervention of a submucous plexus. D = Anastomosing branch connecting two adjacent mucosal arteries on under aspect of *muscularis mucosae.* (× 15.)

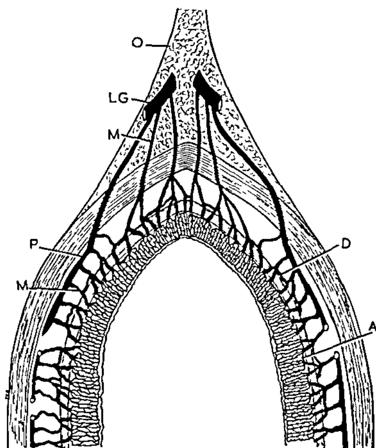


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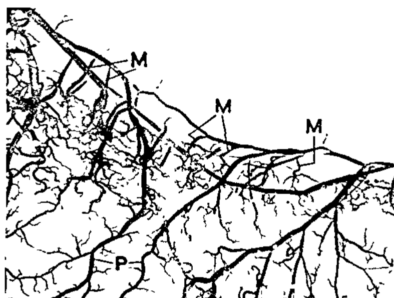
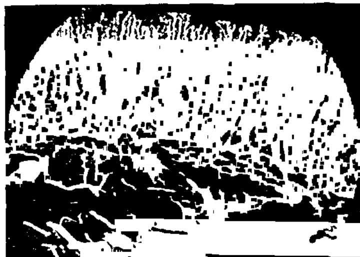


FIG 55.—Radiograph of branches to lesser curve of stomach P = Branches to submucous plexus of anterior wall. M = Branches going directly to mucosa of lesser curve (× 1·8.)

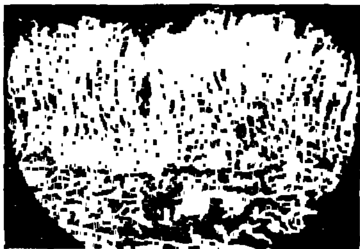


Fi ... the point of

(a)



(b)



(c)

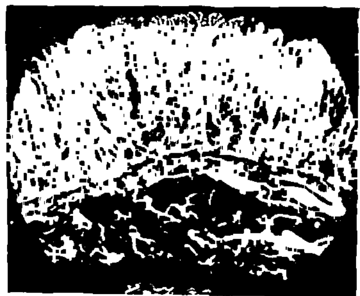


FIG 60.—Radiograph of vessels of mucosa in continuous strip of stomach, from anterior wall, across lesser curve into posterior wall (a) anterior wall; (b) lesser curve, (c) posterior wall. The sections are indistinguishable from each other (× 16)

Arteriovenous anastomoses in the stomach wall

The reawakening of interest in the last few years in arteriovenous anastomoses has introduced a new way of looking at the problem of ischaemia. Ischaemia generally results from failure of blood flow due either to blocked vessels, or, rarely, to a failing circulation. The presence of arteriovenous shunts in a tissue permits the inquiry whether undue diversion of blood from arterial to venous side can produce ischaemia of the tissue distal to the arteriovenous opening. This might be a new way of interpreting Virchow's "aseptic vascular occlusion"—local failure of circulation, due not to local vascular block but to excessive diversion of blood directly from arteries into veins.

Spanner (1932) described arteriovenous communications of capillary size in the vessels of intestinal villi, but there was no knowledge of their occurrence in the human stomach. The presence of large arteriovenous anastomoses in the submucous layer of the stomach was inferred, however, by Barclay and Bentley (1949), as a result, under certain circumstances, of failure to fill by injection the vessels of the mucosa of the excised human stomach, and from changes observed in the oxygen saturation of venous blood taken from the stomach during the first few minutes after the abdomen was opened at surgical operations. Micro-dissections of the stomach wall by Barlow (1951) demonstrated objectively the presence of large arteriovenous communications in the submucous layer of the human stomach, and enough work has now been done to [illegible] clear the general features of these intriguing channels.

[illegible] wall, and co[illegible]eins. The arterial end of an anastomotic channel usually springs from a mucosal artery, though [illegible] mucous plexus (Plate I).

These arteriovenous communications are all simple direct channels, but there are considerable variations in length and directions. Some take a long straight course, except for one or two sinuous waves; others are quite short, the small arteriole doubling back to enter the corresponding mucosal vein. Some have a simple circular direction; but in the majority of instances the arterial part of the vessel is long and winding before it joins a vein, the two vessels usually continuing straight into each other.

At the point of junction of arteriole and venule the channel narrows (Fig. 61); the narrow part is 1–2 millimetres in length, and at this point the lumen may be almost completely occluded. Serial transverse sections through an anastomotic channel show that at the narrow point of junction there is a considerable thickening of the wall of the vessel by large cells in the wall, which bulge and protrude into the lumen (Fig. 62) and which could be considered to represent a closing or controlling mechanism, similar to the large epithelioid cells decribed by Clara (1939).

Arteriovenous channels are to be found in all parts of the stomach, in the anterior [illegible] region. It is usually [illegible] spaced arteriovenous channels arising from the [illegible] the short-circuiting channel is always of much smaller diameter than the parent artery from which it arises (Fig. 61 and Plate I).

The anatomical evidence demonstrates plainly the presence and general features of the arteriovenous shunts, but additional information can be obtained by perfusion experiments. Walder (1950, 1951) has taken the distal two-thirds of the stomach excised at operation of partial gastrectomy for duodenal ulcer, and perfused it for



Coloured print of an arteriovenous anastomosis in the submucosa Arteries red, veins blue An arterial and a

reach the submucous vein. (× 30.)

PLATE I.



FIG 61.—Projection drawing of two arteriovenous anastomoses in the submucosa. A V.A = Arteriovenous loops showing narrow junction of arteriole and venule. M = Mucosal artery P = Submucous plexus (× 50)

some hours, under physiological conditions, with human plasma. If to the perfusing fluid entering the arteries is added a number of small glass spheres of various diameters up to 200 μ, many of them can be recovered from the venous outflow. Spheres up to 140 μ in size are recovered, with a maximum number at about 100 μ, indicating the general size of the arteriovenous channels in life

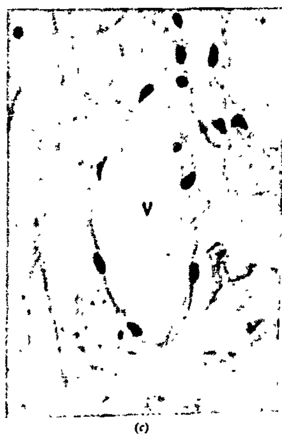
Under different experimental conditions there are marked changes in the numbers of spheres passing, but no change in the average diameter of the spheres, indicating that the shunts are either open or shut, and do not maintain intermediate positions Stimulation of a nerve-leash on the lesser curve, or addition of adrenaline to the perfusing plasma, diminishes the rate of flow of plasma through the stomach vessels, but increases the number of spheres per millilitre of fluid passing through. That is, the total flow is diminished, but the flow through the shunts is increased. Addition of acetylcholine to the perfusing fluid has the opposite effect; the total flow is increased, but the flow through the shunts—as judged by the number of spheres passing from the arterial inflow into the venous outflow—is reduced.

Conclusions

The anatomical and physiological data indicate that arteriovenous anastomoses in the stomach wall are functioning entities, are widespread in their distribution in the submucosa, are up to 140 μ in diameter, and that the flow through the shunts appear to bear an inverse relationship to the total flow through the stomach vascular bed. At the same time there is nothing as yet in this evidence to suggest that a direct relationship exists between the short-circuiting channels and gastric ulceration. The arteriovenous loops are of much smaller diameter than the mucosal arteries

(a)

(b)



(c)

F[illegible] Three sections of the same [illegible]

from which they arise, suggesting that they can never take the same volume of blood as does the parent artery, and that even if the shunts were fully open the mucosa would not be rendered ischaemic unless there was simultaneous active closure of the mucosal arteries and capillaries. More significant still in relation to the ulcer problem is the presence of arteriovenous anastomoses distributed equally in the anterior and posterior walls of the stomach and in the lesser curve. We are not able to distinguish any special arrangement of shunts, either in number, type or position, in the lesser curve region compared with the rest of the stomach, and although this does not exclude the possibility of physiological differences in behaviour in the different parts of the stomach, we cannot conclude on anatomical grounds that the presence of arteriovenous anastomoses provide an alternative interpretation of Virchow's "aseptic vascular occlusion" as a cause of mucosal ischaemia and gastric ulceration.

THE VENOUS SIDE OF THE VASCULAR TREE

Venous obstruction, if sufficiently severe, will also lead to circulatory arrest and tissue necrosis. The possibility that the vascular obstruction responsible for gastric ulcera-



Fig. 63.—The veins of the mucous membrane (× 17)

tion might be in the veins of the stomach wall rather than in the arteries has long been held and was given prominence by Payr (1907) and Wilkie (1911). Their work suggested that retrograde venous embolism or venous thrombosis was responsible for the venous obstruction, and although their findings have not been entirely confirmed, the thesis that mucosal death can be the result of congestion and cyanosis due to an unexplained interference with the venous return is still accepted.

The general anatomical arrangement of the veins of the stomach wall does not suggest that obstruction of the veins could readily occur, for the anastomoses are at least as free as those of the arteries. In the mucosa, blood is collected from the surface capillaries into large venules, about 100 μ in diameter, which lie close to the surface. Several venules unite to form a mucosal vein which runs vertically through the mucosa, pierces the muscularis mucosae and enters one of the large veins accompanying the mucosal arteries there (Fig. 63). From thence onwards the veins follow the

animals and man that under certain circumstances—for instance trauma or disease—the red cells aggregate into clumps which may block the smaller blood vessels, particularly the capillaries and venules, and prevent an onward flow of blood. The obstruction may last only a few minutes, but may continue, when severe, for many hours. Suitably observed in the living state the vessels can be plainly seen distended with red cells, a state of complete circulatory stasis existing in a localized area of the vascular bed. When such a condition is studied in histological section, after fixing and staining, the vessels are noted as distended with blood and the picture may be interpreted as hyperaemia or early congestion. Bigelow, Heimbecker and Harrison (1949) have pointed out that such an interpretation is the reverse of what actually occurs.

In an inquiry into the possible relationship of vascular stasis to acute peptic ulceration Key (1952) has similarly observed that the distended vessels packed with red cells which are seen in histological section surrounding an acute ulcer, and which are usually taken to indicate early hyperaemia and congestion, provide no proof that blood was actually flowing at the time the tissue was excised and fixed, and that the picture can be interpreted as one of early vascular stasis.

In considering therefore the problem of venous occlusion, the possibility arises that obstruction may be due not to gross pathological changes detectable by routine methods of histological section, but to more physiological conditions of vascular stasis, often transient in nature, and only detectable by studies in life. There is no evidence yet that circulatory stasis of this nature is associated with ulceration in the human stomach, but Key (1952) has shown in rats that the acute gastric ulcers which follow prolonged vagal stimulation or ligation of the pylorus are preceded by areas of complete stasis with clumping of the red cells in the capillaries and venules. It is an aspect of the problem which, taken in conjunction with the vascular changes observed in acute ulcers and described below, merits further inquiry.

THE VESSELS OF A GASTRIC ULCER

Acute ulcer

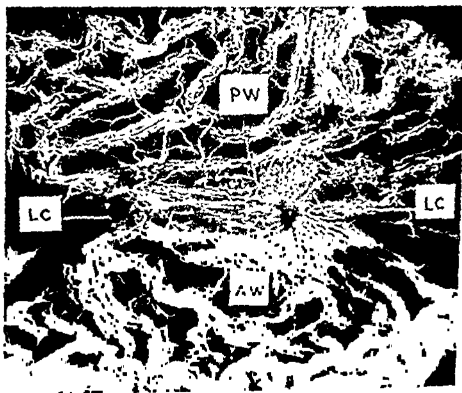
If the vessels of an acute gastric ulcer are examined by the techniques of micro-arteriography, a curious and instructive state is revealed. As was shown by Key (1950) the normal vascular pattern in the submucosa is replaced by a large collection of distended vessels, irregularly arranged and extending over a much wider area in the submucosa than the breach in the mucous membrane (Fig. 65). The mucosa gives the impression of having collapsed on the submucosa, and its vessels appear to be normal up to the margin of the defect or even in the collapsed fragment of mucosal edge. It is likely, but is not yet proven, that most of these dilated vessels are veins. The acute vascular disturbance shown in the submucosa could be interpreted as a condition of hyperaemia or congestion; it could equally well be considered to result from venous occlusion, or to represent local circulatory stasis. Whatever the explanation may prove to be, a feature of the vessels of acute ulcers is the extent of the disturbance and the dilated nature of the vessels in the submucosa, supporting a hypothesis—for further inquiry—that the ulcer arises from a vascular disturbance under the mucous membrane rather than from changes in the mucosa itself.

Chronic ulcer

The condition of the vessels in a chron [illegible]
years' [illegible]
the ulc [illegible]
distance into the anterior and posterior walls. In this area the mucosal arteries and the vessels of the submucous plexus are occluded, as also are the main channels of the left gastric chain in many instances. The ulcer appears as a defect in the centre of an



FIG. 65.—Radiograph of vessels of an acute ulcer of lesser curve. Note extensive development of distended vessels in submucosa and narrow breach of mucous membrane, with well-filled capillaries up to edge of defect. Transverse section across lesser curve, 400 μ thick. (× 8·5.)



Fi[illegible] of vessels of a stomach presenting an ulcer at the centre of [illegible] relatively avascular zone. The stomach [illegible] and laid out flat. LC = Lesser curve [illegible] (B) courtesy of the Brit. med. J.) (× 0·8.)

ischaemic zone (Fig. 66). Sections across ulcers of different ages—as judged by the duration of clinical symptoms—demonstrate vascular changes of a progressive nature. The first change noted is the loss of the normal vessels traversing the submucosa and

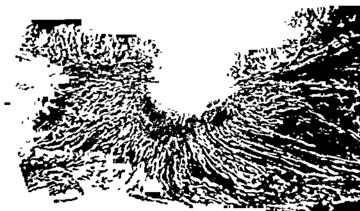


FIG 67.—Radiograph of vessels of lesser curve ulcer of 5–6 months' duration. Normal pattern of arteries and veins in submucosa is lost and replaced by venules radiating from ulcer and extending across full width of lesser curve. Transverse section across lesser curve, 400 μ thick. (× 4.)

their replacement by a large number of fine vessels. Separate investigation, not illustrated here, shows that these blood vessels consist almost entirely of veins. The veins in their turn slowly disappear and the tissue becomes avascular, later the avascular

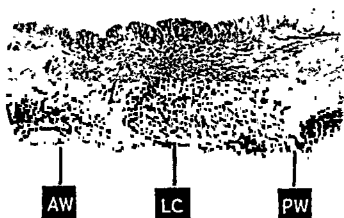


FIG 68.—Radiograph of vessels of lesser curve nearly 1 cm. distal to edge of ulcer shown in Fig 67. Abnormal pattern of vessels in submucosa and muscle coats beneath lesser curve is evident LC = Lesser curve. AW = Anterior wall. PW = Posterior wall Transverse section across lesser curve, 400 μ thick (× 3.)

tissue breaks down and ulcerates These changes are first seen in the submucosa in the floor of the ulcer, and spread, deep in the submucosa, along the line of the lesser curvature but not into the anterior and posterior walls. The mucosa of the lesser curve is in this way undermined and eventually destroyed.

Examination of sections of an ulcer from a patient with 5–6 months' history of indigestion show the early stages of this progressive change. The mucosal vessels fill normally and have normal outlines as far as the edge of the ulcer cavity, but the usual



Fig. 69.—Radiograph of vessels of lesser curve 2 mm. distal to edge of ulcer shown in Fig 67. Ulcerative process is extending in submucosa, undermining mucous membrane. Vessels of mucosa are well filled. Transverse section across the lesser curve, 400 μ thick. (× 3 8.)

pattern of arteries and veins in the submucosa, extending across the full width of the lesser curve, is no longer visible and in its place is a great number of fine venules which radiate from the ulcer through all the coats of the stomach (Fig. 67). This abnormal



Fig. 70—Radiograph of the vessels of a chronic ulcer of the lesser curve. The base of the ulcer is almost entirely devoid of vessels through all the coats of the stomach. Transverse section across the lesser curve, 400 μ thick. (× 3 5)

pattern of vessels can be traced in the submucosa (and to a lesser degree in the musc coats) along the lesser curve for a surprisingly long distance, at least 1 centimetre fro: the edge of an ulcer only 5 millimetres in diameter (Fig. 68). At the proximal and dist. edges of the ulcer, undermining of the mucosa by the ulcerative process deep in th submucosa has already begun (Fig. 69).



FIG 71 —Radiograph of the vessels of the ulcer shown in Fig 70, taken at the [illegible]



FIG 72.—Radiograph of the vessels of an ulcer of the lesser curve of several years' duration. The base of the ulcer is devoid of vessels Transverse section across the lesser curve, 400 μ thick (× 3 5.)

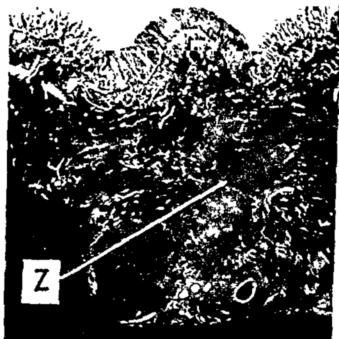


FIG. 73.—Radiograph of the vessels of the lesser curve 7 mm. distal to the edge of the ulcer shown in Fig 72. Deep in the submucosa an ischaemic zone is evident (Z). Transverse section across the lesser curve, 400 μ thick. (× 3·5.)



FIG. 74.—Radiograph of vessels of the lesser curve 3 mm. distal to the edge of the ulcer shown in Fig. 72. The ulcerative process is extending in the submucosa. The vessels of the overlying mucous membrane are well filled. Transverse section across the lesser curve, 400 μ thick. (× 3.)

In a more chronic ulcer, the mucosal vessels still show normal outlines into the margins of the defect but the floor of the ulcer is now almost solid and ischaemic (Fig. 70). The abnormal pattern of vessels starts at the ulcer edge on the lesser curve (Fig. 71), and continues in the submucosa along the line of the curve for 1–2 centimetres; ulceration now extends deep in the submucosa for 2–3 millimetres beyond the ulcer margin.

The development of the ischaemic state continues, and in an ulcer of some years' duration the abnormal pattern of vessels extends 2–3 centimetres in the submucosa along the line of the lesser curvature, but not only is the base of the ulcer devoid of vessels (Fig. 72), but an ischaemic core now exists in the deeper layers of the submucosa extending about 1 centimetre down the lesser curve beyond the ulcer edge (Fig. 73). The ulcerative process follows in the submucosa and now extensively undermines the mucous membrane of the lesser curve (Fig 74).

These findings indicate that so far as the vascular changes of a chronic gastric ulcer may be taken in evidence, the disease is not one of the mucous membrane but of the deeper layers of the stomach wall. In the submucosa extensive destructive changes of vessels occur, and the process extends along the lesser curve in the submucosa, undermining the mucous membrane and replacing the connective tissue of the submucosa and the vascular branches for the supply of the mucous membrane which it contains, by a solid core of avascular scar. There is thus a complete reversal in the pattern of vessels between acute and chronic ulcers of the lesser curve. The change from the acute to the chronic state could be explained simply as the consequence of continuing infection in the submucosa, the ordinary pathological processes of inflammation, following the line of lymphatic drainage in the submucous layer, converting this vascular connective tissue into an avascular scar. In this way a lesion which begins as an acute peptic ulcer—from reasons yet to be discovered—is changed into a chronic ischaemic one. Its original peptic nature is no longer significant and ulceration continues because the blood supply of the ulcer base is not sufficient to ensure sound healing, or to maintain the healed state, as in ulcers elsewhere in the body

The ischaemic nature of a chronic gastric ulcer indicates, too, that little success can be expected from medical treatment of such chronic ulcers, and emphasizes that the chronic ischaemic ulcer of the stomach, with a solid scar base and avascular extension along the submucosa of the lesser curve, can be permanently cured only by surgical excision in the operation of partial gastrectomy.

ACKNOWLEDGEMENT

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(*See also British Surgical Practice* Stomach—Diseases of, Vol 8, page 49, S Key 312)

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ANAESTHESIA

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CONTRIBUTORY FACTORS IN THE EVOLUTION OF ANAESTHETIC TECHNIQUE

The development of operative surgery as a specialized branch of medicine was given its initial impetus by the discoveries of Wells, Morton and Simpson just over one hundred years ago. The original inhalant drugs and methods enabled a wide range of operations to be done and some of the latter, judging from specimens in surgical museums, must have been truly formidable in extent. In time, however, the growth of abdominal surgery began to show up the deficiencies of the old methods of anaesthesia. The latter could still provide fairly satisfactory operating conditions, including good relaxation of muscles, but in long procedures their toxic effects contributed significantly to post-operative morbidity. Recognition of this hindrance to advances in surgery was slow but quite definite, as could be seen in the preference shown for local and regional analgesia, including subarachnoid block of spinal nerves, by those who sought something better.

Apart from abdominal surgery other proving grounds became available in which anaesthetic techniques could be tested and compared. In the neurosurgical field the removal of cerebral tumours in ninety minutes or so as done by Horsley and Sargent was possible under inhaled ether or chloroform; but "the fastidious ritual of the Cushing school" whereby an operation might go on for half a day demanded something different. It is not surprising that in such long operations the first choice was analgesic infiltration for the opening and closing of the cranium, no anaesthetic being required for work on the brain itself because of its almost complete insensitivity. Fortunately, in intracranial surgery full muscular relaxation was not essential, so that general anaesthesia, when employed, as it was later on, could be kept in a light plane just sufficient to ensure immobility and prevent coughing and vomiting which, if active while the dura was open, might jeopardize the procedure and even the patient's life. One particular long-standing problem of neurosurgery, namely the safe handling of tense aneurysms and vascular tumours, has been solved, at least temporarily, by the application of the ancillary technique of reducing arterial tension by arteriotomy. This and other methods of planned hypotension come into the province of the anaesthetist and will be discussed later.

Probably the best experimental field for the development of advances in anaesthesia has been that of thoracic surgery. Operations on the lungs, heart and great vessels involving derangement of respiratory and circulatory functions, either reflexly or by direct interference, provide a severe test for anaesthetic methods and a challenge to anaesthetists to make some worthy contributions to surgical progress. The relatively simple duty of rendering a patient unconscious, unresponsive to stimuli and adequately relaxed, has now been superseded by a more complex one requiring skill to guard the patient against the ill-effects of paradoxical breathing and reflex cardio-

vascular reactions and thus make critical operations on the thoracic viscera easier and safer to perform. With the soluble barbiturates the depth of unconsciousness could be quickly and flexibly controlled. This tempted anaesthetists to explore the possibilities of continuous intravenous administration. Clinical trials in this direction soon proved the barbiturates to be incapable of providing by themselves conditions even as good as those that might be expected from ether and other inhalation anaesthetics. In time it was realized that clinically the predominant effect of the barbiturates is hypnotic and that analgesia is secondary; some observers deny the existence of the latter factor. The dosage sufficient to eliminate response to stimuli and produce relaxation of muscles has a profound depressant effect on the medullary centres, and for major abdominal cases the quantity given and its concentration may be so great that recovery of consciousness is much delayed, sometimes alarmingly so. Although in the past not always avoidable, the continuance of anaesthesia in the post-operative period need not occur with modern methods. Rapid emergence from unconsciousness is generally desirable, and subsequent sedation should be applied only when required and after an appropriate interval rather than as a supplement to the anaesthetic proper. The sphere of real usefulness of the soluble barbiturates is limited. For induction of unconsciousness they are unexcelled, and for this purpose and possibly the maintenance of basal narcosis during surgical operations or other procedures they are likely to be retained in practice for some time to come.

The transition from traditional inhalation anaesthesia to modern methods is still [illegible] long as a need exists for simple and safe domiciliary anaesthetics the search for an agent which is easily administered by inhalation and effective but relatively non-toxic will continue. Success in this matter may well be too late because general anaesthesia is rapidly becoming outmoded, and its suitability as an efficient method for the occasional anaesthetist is doubtful.

Newer drugs

During the past twenty years cyclopropane, divinyl ether and trichlorethylene have had extensive trials, and more recently methyl-n-propyl ether has been introduced. Of these cyclopropane has been the most successful. The use of this hydrocarbon gas in conjunction with the technique of absorption of carbon dioxide undoubtedly halted the decline in reputation of anaesthesia by inhalation, and for some time before the introduction of specific muscular relaxants it probably forestalled a significant changeover to regional analgesia. Much of the reputation of cyclopropane was built on its ability to produce quiet respiration, and even apnoea if desired, at a light general level of anaesthesia. This feature was put to good use in the development of "controlled respiration", which aided considerably the contemporary advances in [illegible] provides [illegible] dified than in the case of other general anaesthetics with the exception [illegible] oxide. Skilfully given and without the unnecessary support of an admixture of ether, cyclopropane provides good relaxation; in the latter respect and in the incidence of respiratory and metabolic disturbances in the post-anaesthetic period it is superior to all other agents of comparable potency. Apart from some minor desirable features divinyl ether and methyl-n-propyl ether do not appear to have any overwhelming advantages over diethyl ether. At one time when this form of anaesthesia was in almost universal use these lesser-known ethers might have found favour in anaesthetic practice; as it is they have arrived in time to share the eclipse of general anaesthetics of traditional type.

Use of electrical apparatus in surgery

A not unimportant factor in the decline of anaesthesia by inhalation has been the ever-increasing use of electrical apparatus in surgery. When diathermy is being applied or endoscopic examinations are in progress the administration of an inflammable agent such as cyclopropane or any of the ethers is contra-indicated. Chloroform and nitrous oxide have been available as non-inflammable alternatives, and more recently trichlorethylene has been introduced in the unsubstantiated hope that it might combine the best features of the other two. Trichlorethylene provides highly satisfactory analgesia and, if necessary, unconsciousness, but cannot be given in a concentration sufficient to relax muscles without at the same time producing side-effects such as tachypnoea and sweating. Experience with both chloroform and trichlorethylene shows the former to be more generally useful. When given with oxygen it has the smoothness and flexibility of control seen with cyclopropane. Interest in this discarded but once popular agent has been reawakened by the recent investigations of Waters (1951) and his co-workers at Madison. These observers state that with modern methods of administration this most powerful and effective of all general anaesthetics may be less dangerous than reputed. Present-day interest in induced hypotension recalls the claims formerly made for chloroform in this connexion, and some work has been done (Gillies, 1950) confirming those claims. As with other inhaled vapours, however, the use of chloroform in the future is likely to be limited to that of a supplementary narcotic given in a low and relatively safe concentration, just enough to produce analgesia and unconsciousness, while any muscular relaxation required is obtained by more specific means.

Advances in drug administration

Apart from new drugs, technical refinements in their administration, as for example by the closed-circuit carbon-dioxide absorption method, have been responsible for improved operating conditions and a considerable reduction in post-anaesthetic morbidity. An interesting contribution towards mechanized control and perhaps greater safety in general anaesthesia has been made by Courtin, Bickford and Faulconer (1950) in their ingenious method of electro-encephalographic regulation of the concentration of ether. A similar investigation in respect to thiopentone has been made by Kiersey, Bickford and Faulconer (1951). In a different field of research Laborit and Huguenard (1951) have explored the possibility of potentiating the action of general anaesthetic agents by means of certain antihistamine substances derived from phenothiazine. The supplementary drug is given intravenously for the specific purpose of lowering the patient's temperature and basal metabolic rate. A semi-comatose state like hibernation follows, and the amount of anaesthetic required thereafter may be only 25–50 per cent of what would be necessary in ordinary circumstances. However, despite these artifices and the new drugs and methods, it is plain that general anaesthesia by itself can no longer meet the requirements of the surgeon and at the same time adequately support patients against the stresses of the extensive operations of today.

MUSCULAR RELAXATION

When administered skilfully general anaesthetics without adjuvants are capable of producing satisfactory muscular relaxation. If, however, the latter has to be maintained for a long time saturation of the tissues by the anaesthetic drug takes place, a process which in the past has often been an important contributory factor in the causation of post-operative morbidity and mortality. For this reason and because of the extreme ease with which muscular paralysis seemed likely to be achieved in the

future, surgeons and anaesthetists welcomed the introduction of specific relaxant agents, headed by curare. Since then these adjuvants have become firmly established in anaesthetic practice, and their merits have been proved. The main facts concerning curarization are well known to clinicians and thus this survey need only be brief.

Specific relaxants

Curare had been known to physiologists for over one hundred years. In 1840 Claude Bernard described his clinical experiments in which he showed that curare blocked the transmission of nerve impulses at neuromyal junctions. Apart from small-scale therapeutic applications, such as treatment for the spasticity of voluntary muscles seen in certain conditions, for example tetanus, this drug retained only an academic experimental interest. The isolation by King (1935) of the crystalline alkaloid, dextro-tubocurarine chloride, stimulated fresh inquiry thereafter. Further pharmacological investigation was made by McIntyre and King (1943). Acting on a suggestion from McIntyre, Bennet (1940) administered Intocostrin, a physiologically standardized extract of curare, to patients undergoing electro-convulsive therapy, his purpose being to modify the violence of muscular contractions occurring during the convulsions. The same preparation was used by Griffith and Johnson (1942) of Montreal, for the first time, as an adjunct to surgical anaesthesia. Following this the general adoption of curarization as a part of anaesthetic technique was stimulated by the work of Cullen (1943), Cole (1945) and Whitacre and Fisher (1945) in the United States of America, and by Gray and Halton (1946) and Prescott, Organe and Rowbotham (1946) in Great Britain. The British workers used *d*-tubocurarine chloride which, fortunately for the principle concerned, was from the beginning uniformly effective and manageably safe. This agent still provides the standard by which other muscle-relaxants are judged.

Several synthetic alternatives have passed through experimental and clinical trials into anaesthetic practice. Among these are gallamine triethiodide or Flaxedil (Bovet and colleagues, 1946), decamethonium iodide or C10 (Paton and Zaimis, 1948) and dimethyl-tubocurarine iodide (Collier and others, 1948). In a comparative review of the relaxants, Scurr (1951) agrees with Harris and Dripps (1950), as would most anaesthetists, that there is little or no difference in the quality of muscular relaxation obtained from the several dugs named. They differ considerably, however, in mode of action, duration of blocking activity of equipotent doses and in their side-effects.

Mode of action

D-tubocurarine chloride, dimethyl-tubocurarine iodide and gallamine triethiodide cause muscular paralysis by preventing acetylcholine from carrying out its intermediary part in transmission of motor impulses. Normally, when released at the terminals of motor nerves this agent immediately depolarizes the adjacent muscle-membrane and so there is generated the action potential necessary to excite (or stimulate) the muscle fibres. After injection of a curare-like drug acetylcholine continues to form at the motor end-plates but now it appears to be incapable of affecting the muscle membrane. Consequently the muscles remain atonic. Decamethonium iodide acts in quite a different way. This agent depolarizes the muscle-membrane [illegible] does and [illegible]

Antidotes

The dissimilarity of action is important when considering antidotes to the drugs of the two groups. In the former the curare-like effect of the three drugs included may

be neutralized by the injection of Prostigmin, which combines with and removes cholinesterase—the natural destroyer of acetylcholine. The resulting accumulation of acetylcholine surmounts the barrier, and activation of muscular contraction is resumed. Where Prostigmin becomes necessary atropine also should be given, preferably a little time earlier, in order to prevent excessive bronchial secretion. In the second group, which includes decamethonium iodide, the problem of an effective enzymatic or chemical antidote is as yet unsolved Prostigmin is useless in this instance because its point of attack is inappropriate; by destroying cholinesterase it allows a build-up of acetylcholine which may well reinforce and prolong the depolarizing action of decamethonium iodide. To counteract the effect of the latter or any similar drug for which there is no antidote it is important that adequate pulmonary ventilation be maintained as long as necessary. Such a measure should be regarded as essential even when effective antidotes are available.

Duration of activity

The duration of blocking activity of equipotent doses of the several relaxants under discussion varies considerably According to Collier and colleagues (1951) the figures for man in unspecified units of time are: *d*-tubocurarine chloride 100, dimethyl-tubocurarine iodide 83, gallamine triethiodide 70, and decamethonium iodide 79. As these figures were probably obtained from hand-grip tests on human volunteers they must meantime be considered less useful to the clinician than those based on admittedly approximate observations of the duration of paralysis produced by relaxants in the abdominal muscles of lightly narcotized patients. Thus Scurr (1951) gives times which show considerable variance from the ratios quoted from Collier; they are stated in minutes as follows *d*-tubocurarine chloride 30–45, dimethyl-tubocurarine iodide 30–40, gallamine triethiodide 25–30, and decamethonium iodide 15–20 In the administration of single or repeated doses of relaxants the duration of action is, as in [illegible]

of action that the frequency of repeating the injections becomes a nuisance. Some procedures, such as electro-convulsive therapy, orthopaedic manipulations or tracheal intubation, might best be served by muscular relaxants of even shorter duration of action than those already considered. This particular advantage is likely to be satisfied by new ultra-short-acting relaxants at present undergoing clinical trial. In this category are compounds of succinylcholine which have been investigated experimentally and clinically by Bovet and his co-workers (1949, 1951), Castillo and de Beer (1950a, 1950b), von Dardel and Thesleff (1951) and Holmberg and Thesleff (1951) Like decamethonium iodide these new compounds cause muscular paralysis by persistent depolarization of muscle-membrane at the motor end-plates. Their period of blocking activity is transient, lasting only 2–8 minutes; this is believed to be due to rapid hydrolysis by cholinesterase—a fate similar to that of acetylcholine.

It is too early yet to assess fully the value of the ultra-short-acting relaxants. As with all new agents adequate evidence must be accumulated before any assessment is attempted. Meantime it is worth noting that a case has been reported (Harper, 1952) in which the action of one such relaxant persisted for some hours but with no untoward effects ultimately

Side-effects

Certain undesirable but avoidable complications associated with the use of muscle relaxants are now less common because of better management of the

procedure. Apnoea and the more insidious subnormal tidal exchange are now competently corrected by *controlled or assisted pulmonary ventilation*. The dangers of impedance of carbon dioxide with its sequelae of hypertension and excessive bleeding or in extreme cases grave medullary depression are well-known and are readily obviated.

The incidence of unavoidable *side-effects is the criterion which usually* determines the final selection of a particular agent from amongst several which may all be equally satisfactory in their main pharmacological action. In the dosage required to relax muscles adequately for surgical operations none of the specific relaxants under discussion exhibits serious or unmanageable subsidiary *actions. The side-effects that have* been observed are related to the mode of action of the drugs concerned. Those that act by inhibiting the activity of acetylcholine at the neuromyal junctions are capable of affecting other mechanisms mediated by this substance. According to Dale (1934), acetylcholine is released at the terminals of the preganglionic sympathetic fibres and at the terminals of most of the fibres of the parasympathetic nerves, as well as at the motor end-plates in skeletal muscles. Thus *d*-tubocurarine chloride and drugs with a similar action may block sympathetic and parasympathetic transmission, but there is some individual variation in the extent to which this occurs. Gallamine triethiodide, for instance, in minimal effective doses consistently produces tachycardia which could be due to blocking of the parasympathetic ganglia, an action similar to that of atropine. The extent to which the same agent blocks sympathetic pathways is not fully known although the increased vascular oozing seen in operation wounds may indicate some inhibition of vasoconstriction.

The effects of the more powerful relaxant, *d*-tubocurarine chloride, seem to be balanced in respect to the two parts of the autonomic nervous system. It may, by interrupting sympathetic transmission or by liberating histamine, cause vasodilatation and a fall of blood pressure. Such hypotension is not common. When it occurs it is usually related to large dosage. Other factors, however, enter into the mechanism of hypotension and therefore further discussion will be deferred meantime and included in a later section.

The relaxants which act *by direct depolarization do not in ordinary dosage appear* to affect transmission in autonomic nerves and are relatively free of undesirable side-effects. To this group belong decamethonium iodide and the closely related ultra-*short-acting relaxants derived from certain compounds of succinylcholine.* The bis-*choline ester of succinic acid has* undergone successful trials by the several observers already quoted. In the case of this drug it is an interesting surmise that the absence of side-effects is probably due to its complete hydrolysis by cholinesterase enzymes into succinic acid and choline, two natural metabolites of non-toxic character.

Despite the fact that so far they have no known antidotes depolarizing agents may, in future, displace the classical curare-like muscle relaxants in anaesthetic practice. Some method of prolonging their action will be necessary, however, if they are to be employed in major surgery. To preserve the high safety factor which they possess by virtue of their ready destructibility, the means employed to provide such prolongation should be continuous administration by intravenous *infusion rather than biochemical* interference with normal hydrolysis, as, for example, by the synchronous administration of the anticholinesterase, Prostigmin.

Complementary basal narcosis

Muscle relaxants have no analgesic or hypnotic properties and therefore, throughout any surgical operation in which they are employed, basal narcosis must be maintained. This need only be enough to keep the patient unconscious and non-reactive to painful or other stimuli, purposes which may be served by inhaled or intravenous anaesthetic agents in low concentrations. Whichever method is chosen *the patient*

must be connected to an anaesthetic apparatus in order that pulmonary ventilation may be aided by the anaesthetist during the period of muscular paralysis and until breathing is fully spontaneous. Of the gases used as basal narcotics to accompany specific relaxants, nitrous oxide with oxygen is a common choice. This gaseous mixture is innocuous and non-inflammable but frequently it is inadequate in potency and has to be reinforced. For such a purpose ether or cyclopropane in relatively non-toxic dosage is suitable unless sparking electrical apparatus is being applied in proximity to the patient. In the latter event the vapour of chloroform or trichlorethylene carried in the stream of nitrous oxide and oxygen is effective in producing smooth basal narcosis.

As alternatives to the inhalants named certain hypnotic and analgesic drugs given by intravenous injection may be preferred Thiopentone sodium is employed in this way, but on account of its poor analgesic quality an undesirably high concentration in the body has to be maintained. It must be recognized that the soluble barbiturates which are now regarded as almost indispensable for the induction of anaesthesia and for short procedures have otherwise only a restricted sphere of profitable application.

Some years ago James (1944) advocated intravenous morphine as a satisfactory narcotic accompaniment to local and regional analgesia. This combination which spared the patient a considerable amount of general anaesthetic poisoning, particularly in extensive abdominal operations, has a present-day counterpart in the use of intravenous pethidine conjointly with nitrous oxide and oxygen and a muscle relaxant Pethidine was first introduced into anaesthetic practice by Neff of San Francisco in 1947, since when he, together with Mayer and Thompson (1950), described a modified technique which differs from that of Mushin and Rendall-Baker (1949, 1950) and others in that unconsciousness is initially induced by the slow administration of nitrous oxide and oxygen instead of thiopentone. Pethidine, as the main analgesic, and a muscle relaxant are injected intermittently and independently according to the respective needs of the patient and surgeon. Emergence from basal narcosis produced by a mixture of nitrous oxide, oxygen and pethidine is usually rapid but quiet and with little or no disorientation. When skilfully managed Neff's method provides good operating conditions with truly minimal side-effects, which must represent almost the lowest limit of toxicity that may be attained in any anaesthetic procedure providing the three essentials, unconsciousness, analgesia and muscular relaxation. Work along similar lines featuring a new analgesic (3 hydroxy-n-methyl morphine hydrobromide) has been reported by Brotman, Cullen and Wilkins (1950) and more may be expected of such investigations which seem likely to produce an anaesthetic technique possessing the full effectiveness of deep general anaesthesia and the safety of a simple nerve-block.

LOCAL AND REGIONAL ANALGESIA

The combination of muscle relaxant and basal narcotic has in a few years almost completely ousted straight general anaesthesia. For a considerable time before this dramatic change set in the suitability of general anaesthesia for major surgery was being doubted and a definite trend to replace it, wholly or in part, by local or regional analgesia had developed. In some European clinics surgeons had for many years preferred nerve-block in various forms, ranging from local infiltration to subarachnoid injection Originally the choice may have been a reflection on the low standard of general anaesthetics available, but later it was probably based on a perception and appreciation of the less toxic character of localized analgesic procedures, especially

workers made to surgical progress. Undoubtedly such methods have merits and advantages which will ensure their survival and a bigger part for them in anaesthetic practice in the future.

Procaine hydrochloride

Procaine hydrochloride is the safest and probably the most generally useful of the analgesic drugs. When absorbed into the blood stream it is readily broken down by procaine esterase. Its duration of action is much shorter than that of amethocaine or cinchocaine (Nupercaine) but is adequate for many operations. Apart from local or regional application procaine may be given by intravenous infusion in order to produce generalized analgesia; in this way post-operative pain may be relieved and minor surgical work such as dressings and the primary treatment of burns carried out painlessly. Recently this agent has won some repute as a means of preventing or treating the cardiac arrhythmias associated with anaesthesia and intrathoracic operations. Much experimental and clinical investigation has been done and is continuing but the results so far have been somewhat inconclusive. It is probable that the property claimed for procaine hydrochloride of being able to raise the cardiac threshold to stimulation and to prolong conduction time in the ventricle is common to a number of agents In a broad experimental field similarities in the pharmacological properties of local analgesics, quinidine, atropine and pethidine have been demonstrated and indicate a need for care in respect to possible synergic activity when some of these drugs are used together, as they may be in anaesthetic procedures.

Xylocaine

Xylocaine, synthesized by Löfgren and Lundquist in 1943, is reported to have certain desirable features which, if confirmed, may give it a leading place among the familiar analgesics already mentioned. Like procaine, this new drug acts quickly after injection, but differs from the former in being long-acting and effective for 2–3 hours, and having no vasodilator effect. In equal concentrations xylocaine is more potent than procaine, and this together with its rapidity of action seems to indicate that for safety in clinical use weaker solutions might be advisable; for example, 1·5 per cent or even 1 per cent instead of 2 per cent as recommended, and adrenaline should be given with it to reduce the rate of absorption into the blood. Xylocaine was first used clinically by Gordh (1948) of Stockholm. Since then a number of favourable reports have been published. At the moment these lack the essential backing of numerically adequate series to confirm or deny the advantages claimed by individual observers.

Ablett, Dawkins and Steele (1951) consider xylocaine to be particularly effective for extradural nerve block and state that the resulting analgesia and muscular relaxation are fully equal to those provided by subarachnoid block. This is what might be expected as the only difference in the relationship of the injected analgesic solution to the spinal nerve roots is that in subarachnoid block there is quick dilution of the agent by cerebrospinal fluid whereas in extradural injection the concentration is [illegible] under [illegible] inis-tered by the same route. Doubtless its potency and particularly its rap[illegible] well-sustained action are the factors responsible.

Extradural block

Wide individual variation in the capacity of the extradural space accounts for an irreducible minimum of failures associated with this technique. Apart however from the small risk of failure, extradural block is effective in providing satisfactory operating conditions by paralysing spinal nerves close to their origins without any breach

of the vulnerable theca unless by accident. Although extradural analgesia has definite merits it has been used clinically only on a small scale, possibly because of the increased time and trouble required for its proper performance compared with the speed and seductive simplicity of alternative procedures. At present its main sphere seems to be obstetrics, especially prolonged labour, in which analgesia may be maintained by interval injections of an analgesic through a malleable needle fixed in the caudal canal or a plastic catheter passed into the extradural space at a higher level. In surgery extradural block has been applied successfully in genito-urinary and other pelvic operations on elderly patients in poor physical condition for whom the absence of toxic anaesthetic effects is a considerable advantage.

Spinal analgesia

Spinal analgesia will be discussed later under "Induced hypotension" (page 141) but a few general observations on its present status may be conveniently included now. This method has had more variations in fortune than any other technical process in the whole range of anaesthetics and of surgery. Its periodic eclipses have never been total or permanent, however, and although the allegiance of many of its users has been readily undermined, it has had some constant adherents who have proved its worth and ensured its survival in clinical practice. Like any other technique requiring meticulous performance, spinal block has from time to time been brought into disrepute chiefly by occasional or unskilled exploiters, of whom there have been far too many. In the days when adequate muscular relaxation was difficult to achieve by the simple unaided inhalation methods then available spinal block offered what appeared to be an easy alternative. Too often, however, the making of a spinal puncture and the injection of an analgesic drug were considered the beginning and the end of the procedure. The essential character of certain details in the management of the paralysed patient was not always fully understood, and extreme physiological changes when they occurred were often regarded almost fatalistically Such an attitude sometimes led to disaster and, following this, condemnation of the method rather than the individual responsible.

It is highly probable that the specific muscular relaxants have displaced spinal analgesia from clinical practice to a significant extent. Naturally, any easier method of obtaining equivalent results is likely to be preferred, but it would be unfortunate if this were the only basis of discrimination, especially as the two methods under consideration are in competition only on one point, the mechanism of producing muscular relaxation.

Despite the discouraging influence of periodic articles on neurological and other complications of spinal block, work in this field has continued, especially in the United States of America, where several modifications have been developed. One particular aspect of the method that has received much attention concerns the prolongation of the effective period of sensory and motor block during long operations. Lemmon (1940) and later workers provided one solution to the problem by repeating when required intrathecal injections of procaine through an indwelling spinal needle made of malleable German silver. Tuohy (1944) improved this so-called continuous spinal technique by introducing a special needle through which a ureteral catheter could be placed in the subarachnoid space and fixed there after removal of the needle. With care good results can be obtained by this method, but it is possible that the retention of a gum elastic or plastic tube within the theca for a number of hours may be a contributory factor in any subsequent neurological damage. Many reports have been published of arachnoiditis and lesions of the cord attributed to spinal block, the most recent by Kennedy, Effron and Perry (1950) who have described 11 cases exhibiting neurological complications It may be significant that in 5 of the 11 an indwelling catheter had been used.

A less complicated technique for prolonging an intrathecal block has been reintroduced by Bonica and his co-workers (1951), who state that the addition of epinephrine or Neo-Synephrine to the analgesic will increase the duration of effectiveness of the latter by 50 per cent without raising the incidence of nausea, disturbances of blood pressure, headache or other neurological complications or sequelae.

Many surgeons and anaesthetists still show considerable anxiety regarding the fall of blood pressure that may accompany spinal block. In order to mitigate such a fall pressor drugs are often given, usually before the lumbar puncture and injection but sometimes throughout operation and for some days afterwards, as described by Evans (1944). The latter gave adrenaline (0 0004 per cent) by continuous intravenous drip to maintain the blood pressure at normal level. Hewer (1948) gives warning that a severe circulatory collapse may take place after the administration is discontinued. This danger may be explained by the observations of Bulbring (1944), who demonstrated that wherever acetylcholine acts as a transmitter of nervous impulses, adrenaline modifies its action, and the giving of adrenaline in its smallest effective dosage augments transmission across sympathetic ganglia.

Spinal analgesia has too many valuable features to allow it to be discarded from practice. It provides operating conditions which are unexcelled by any other method of anaesthesia. Muscular relaxation, sensory blockade and, if desired, planned hypotension, may be obtained simultaneously by a small dose of a relatively non-toxic drug. Sparing of the respiratory muscles, a quality vainly sought in muscle relaxants, is possible to an adequate extent during spinal block carefully controlled as to its level. The inherent hazards of the method can be circumvented by unrelaxing intelligent management.

Whenever possible a patient having an operation under local or regional nerve block should be kept unconscious while in the operating room, an advisable refinement which provides psychical protection and facilitates efficient control of pulmonary ventilation should this become deranged, as it may during thoracic or thoraco-abdominal operations. Unconsciousness may be induced and maintained by simple means such as an intravenous barbiturate, nitrous oxide and oxygen or a combination of both; no analgesia is required of the sleep-producing agent as is the case when specific muscle relaxants are being used.

[illegible] ...on the technique employed, [illegible] ...nary operating [illegible] ...d to the nerves supplying the area. This stands in remarkable contrast to general anaesthesia, which may produce equivalent conditions but only after involving the patient's body entirely. Although not completely analogous, an interesting quantitative comparison may be made of local and general analgesia, using procaine hydrochloride for both purposes. Injection of 150 milligrams of this agent into the subarachnoid space or the infiltration of a comparable quantity around spinal nerves in the paravertebral region, or among their terminals in the abdominal wall, will usually provide motor and sensory paralysis for nearly one hour, but over the same period 1,000 milligrams by intravenous infusion will produce general analgesia only with no loss of consciousness and little or no muscular relaxation. The deduction that may be made from this in respect to general anaesthesia and regional analgesia is obvious and valid.

The merits of nerve-blocking and the new technique of combining a muscle relaxant with a narcotic are less easily differentiated. The muscle relaxant serves one specific purpose only—motor paralysis. It has no effect on sensory receptors and

therefore the essential blocking of painful and other afferent impulses must be covered by basal narcosis on a deeper plane than the simple unconsciousness which suffices as an accompaniment to local and regional analgesia. Theoretically at least, the advantages appear to be in favour of nerve block, but from the practical point of view the technical simplicity of producing muscular relaxation by intravenous injection of a muscle relaxant compared with the greater skill needed for effective nerve blocking determines the present overwhelming preference for the former. It is possible that in time local and regional methods of analgesia will get fuller recognition and attain the high place they deserve in anaesthetic practice.

PLANNED HYPOTENSION

Planned hypotension may be defined as the controlled reduction of blood pressure during surgical operations with the object of preventing profuse or troublesome bleeding The latter, even when slight, often prolongs an operation, and it may spoil the final result in certain cases in which precise anatomical dissection is paramount. A large, or relatively large, loss of blood endangers life unless full replacement is made quickly. The seriousness of bleeding for the patient and the hindrance it imposes on the surgeon were soon realized in neurosurgery. According to Dott (1933) Harvey Cushing handled the problem realistically in his time by accepting its inevitability and recognizing that a reduction in blood volume could be helpful during the removal of cerebral tumours by lowering the tension in them and so permitting easier and safer handling. Throughout the critical period the blood volume and pressure were allowed to remain subnormal while the shed blood was collected by suction, filtered and returned intravenously to the patient towards the end of operation or earlier if necessary. It is of some interest that, at present, in at least two neurosurgical clinics in Great Britain a modernized version of Cushing's basic idea in the form of controlled blood volume by arteriotomy is being successfully employed as a means of avoiding excessive bleeding.

In the history of surgical anaesthesia the effects of various drugs and methods on bleeding have often been discussed, but seldom conclusively. The extent to which particular anaesthetics may, through their pharmacological actions alone, modify bleeding by augmenting or decreasing it will be considered later in this section. Meanwhile it should be recalled that technical faults in the management of general anaesthesia are much more responsible for excessive bleeding than are the agents employed. The common avoidable faults include failure to correct respiratory obstruction in any of its several forms and inability to recognize a rising tension of carbon dioxide and facilitate its clearance during periods of depressed respiration. Both cause an increased flow of blood at the site of operation, the former because of a build-up of venous pressure, the latter as a result of raised arterial pressure.

Before the introduction of special methods of inducing hypotension the most reliable means of obtaining an ischaemic field of operation in any part of the body other than the limbs, where a tourniquet might be applied, was infiltration of the area by adrenaline. This vasoconstrictor or an equivalent such as epinephrine is usually added to analgesic solutions to delay their absorption and thus prolong the local effect The aid given to haemostasis is of great advantage so that sometimes in patients under general anaesthesia the site of operation is infiltrated with adrenaline (0 0004 per cent) alone. When only a small area is involved, as in the operation of fenestration for otosclerosis, an equally weak solution of the vasoconstrictor may be applied directly and intermittently as required. These two variations in the localized production of vasoconstriction and ischaemia cause little, if any, general physiological disturbance and are the least toxic of all the methods employed to restrict bleeding.

Major Methods of Inducing Hypotension

There are several different ways in which a patient's blood pressure may purposely be lowered during a surgical operation. The mechanisms involved and the extent to which they are effective vary considerably. Although much clinical investigation has been done and reported, conclusive comparative assessments of the techniques are not yet possible.

Hypotension by arteriotomy

Reference has already been made to the observations and practice of Cushing in regard to the advantages of a temporary reduction of blood volume during intracranial operations. Later Gardner (1946) described a method of "controlled induced hypotension by arteriotomy" which provided easy and quick adjustment of the level of arterial pressure. This work was the clinical counterpart of experiments by Kohlstaedt and Page (1943) who, while studying shock, found that a set level of circulatory hypotension could be maintained by small bleedings and re-infusions through an arterial cannula. Bilsland (1951) and Mortimer (1951), both working in neurosurgical units, have developed the technique more fully. The artery usually chosen for cannulation is the radial, which throughout the procedure remains in continuity with a reservoir containing blood drawn from the patient. Appropriate anti-clotting measures ensure a free flow of blood in either direction through the connecting tubes.

In applying this method blood is withdrawn in stages, 500 millilitres being the average initial quantity. Smaller amounts are taken off at intervals until the arterial systolic pressure reaches a level of about 80 mm. Hg which is maintained by further withdrawal or re-infusion when required (Fig. 75) If gravity is not sufficient ext pressure to drive blood back into the patient's artery may be cautiously applied b means of air from a hand-bellows or oxygen from a cylinder. A Macintosh-Pask dr chamber incorporated in the apparatus prevents entry of air into the artery in the eve of the reservoir becoming completely emptied of blood (Macintosh and Pask, 1940 At a suitable time, normally when the operation is nearing completion, final re infusion is started and continued slowly. Frequently the pre-operative level of bloo pressure is restored before all the withdrawn blood has been returned; the surplu may be given slowly by intravenous drip during the immediate post-operative perioc When intra-arterial infusion is finished, the radial artery may be ligated or repairec In Bilsland's series of 63 cases no lasting ill-effects followed ligation, although in few cyanosis of the fingers and mottling of the skin of the forearm were present fo a period up to 48 hours. Mortimer, on the other hand, considered restoration of th continuity of the vessel to be preferable to permanent occlusion despite the higl incidence of thrombosis which he encountered. These observers noted that the intra arterial route has certain advantages over the intravenous one in respect to the speec and effectiveness of resuscitation. In a report of new work on this subject Seele (1951) states that intra-arterial infusion of blood may be a life-saving measure ir patients suffering from profound shock and even coronary thrombosis because of the rapid perfusion of the coronary vessels which occurs.

So far, controlled hypotension by arteriotomy has been practised only on a small scale in a limited sphere. The method has proved of definite value in neurosurgical operations where the deliberate reduction of blood volume and lowering of arterial pressure cause a fall in general intracranial tension and often a convenient shrinking of a tense brain, highly vascular meningioma or aneurysm; the reactionary vaso-constriction present contributes to these effects, and by decreasing blood flow prevents excessive bleeding. It might be thought that such interference with circulatory activity would cause anoxic changes in the brain, liver and kidneys followed by further

circulatory depression, possibly irreversible in character. On the contrary, these ill-effects can be avoided so long as management of the technique is competent, the patient is well oxygenated, and the accompanying general anaesthesia is light and non-toxic. Increased frequency of the pulse and respiration indicate the need for more oxygen or more blood to carry it to the tissues.

Observations to date support the view that generally an arbitrary level of systolic pressure of 80 mm. Hg is safe even if allowed to continue for as long as three hours. In dealing with anaemic or hypertensive individuals, however, it is advisable to stabilize the pressure at 90–100 mm. Hg, which is usually sufficient in the circumstances to induce a vasoconstrictive response and a satisfactory degree of ischaemia. The total

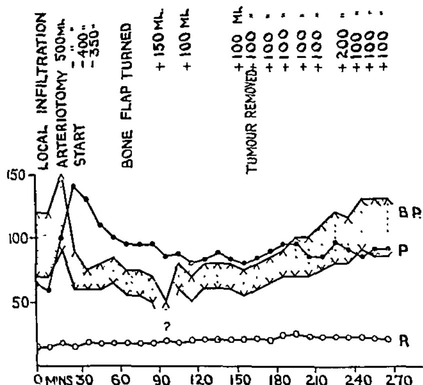


FIG 75 —Male, aged 43 years Operation excision of orbital tuberculoma Pre-operative blood pressure 122/70 Anaesthesia local infiltration, thiopentone 1 3 gramme, nitrous oxide and oxygen Arteriotomy· 1,750 millilitres of blood withdrawn, 1,350 millilitres re-infused Horizontal supine position

quantity of blood that may have to be withdrawn to maintain the levels mentioned depends on the state of the patient's circulation immediately before and also during operation; it varies within wide limits in the order of 250–2,500 millilitres.

As vasoconstriction is the main haemostatic factor in the technique, positioning of the patient plays no primary part in the production of a bloodless field. This is in notable contrast to the hypotensive methods to be discussed presently, which are based on generalized vasodilatation and pooling of blood in dependent parts of the body.

The scope of arteriotomy as a method of inducing and maintaining hypotension is likely to remain limited, it is almost an operation in itself and its wider adoption seems hardly justifiable.

Hypotension by vasoconstrictor paralysis and posture

The techniques most commonly practised at present involve the principle of reducing the patient's blood pressure by a combination of vasoconstrictor paralysis

and postural adjustment; the former produces generalized vasodilatation, th is a means of modifying venous return and cardiac output to some suitable In a fully relaxed vascular bed gravitational pooling of blood can be contriv if the site of operation is at a higher level than the rest of the body, the bloc in the area will be significantly diminished.

General anaesthesia

Before discussing specific methods of abolishing vasoconstrictor tone, the bilities of general anaesthetics in this respect and the extent to which they augn decrease bleeding must be considered. Apart from hypertension, prolonged cl time and venous congestion arising from pathological conditions or faulty thetic technique, the factors which may influence the amount of bleeding from i tissues are vasodilatation, pulse pressure and the depth of anaesthesia.

Vasodilatation develops during induction of anaesthesia and continues thi out; in the early stages it chiefly involves the capillaries of the skin, but later v deep plane is reached the dilatation becomes generalized. All the volatile anaesi and the barbiturates produce this vascular change but differ in their ways of doi In the case of chloroform there is from the first depression of the vasomotor and active peripheral vasodilatation; this agent has also an inhibitory action heart whereby the output of the latter falls. The combination of these effects a reduction of arterial pressure and of blood flow at the site of operation. With on the other hand, the superficial vasodilatation seen is probably a passive op up of the vessels following an increase in cardiac output and a rise in blood pre the latter are manifestations of the initial sympathetic stimulation and splan vasoconstriction which ether is reputed to produce, and they are responsibl profuse capillary oozing which persists until anaesthesia is deepened. During cyclopropane anaesthesia arterial pressure usually remains normal, but blood through the tissues is increased as a result of vasodilatation and raised cardiac put. Intravenous barbiturates cause central depression and generalized vasod tion, there may be a transient fall in blood pressure, which returns to normal whe drug becomes uniformly distributed in the tissues and its concentration is maint at a safe leve[illegible]

The vasodi [illegible] the blood in [illegible] decreased no. [illegible] adjustments are still possible.

Pulse pressure varies with the general anaesthetics employed in accordance the different pharmacological actions of these agents; it is also affected in each i vidual instance by the plane of anaesthesia. In light ether or cyclopropane an thesia the pulse pressure is raised, in the former because systolic pressure is incre relatively to the diastolic, in the latter because diastolic pressure is lowered while systolic level remains unchanged. In contrast to these chloroform produces a fa pulse pressure mainly on account of its vagal activity and a reduction in car output. Effects somewhat similar but usually of short duration are produced by barbiturates.

From the foregoing observations it would appear that except in the case of chlo form, light anaesthesia conduces to troublesome capillary bleeding and someti excessive loss of blood. Surgical stimuli may aggravate this situation by initia reflex changes. If operative trauma is moderate, rises in blood pressure, pulse pres and respiratory rate will take place; if severe, sudden medullary depression may en When anaesthesia is deep, vasodilatation is generalized, blood pressure falls reactions to stimuli are minimal or absent. In such circumstances blood flow considerably reduced and a relatively ischaemic field of operation may be obtain

Clinically, therefore, hypotension may be purposely produced by any potent general anaesthetic, even cyclopropane. If, however, the deep anaesthesia required to achieve this aim has to be prolonged, the associated toxic effects make its use unjustifiable. There are still occasions, as in the past, when chloroform may be applied to prevent excessive bleeding. Given with oxygen after induction with a barbiturate this agent even when maintaining only a light plane of anaesthesia can be made to lower systolic pressure to 80 mm. Hg with safety, at which level a considerable reduction in bleeding takes place and operations such as excision of glands of the neck, or stellate ganglionectomy, may thus be relieved of one important difficulty (Fig. 76). In abdominal operations, if a muscle relaxant is being employed the choice of chloro-

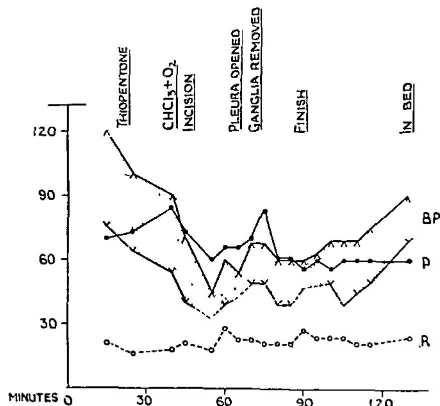


Fig. 76. Female aged 24 years. Operation: [illegible] dorsal sympathectomy. Pre- [illegible]

form and oxygen for the accompanying basal narcosis has, in addition to its useful hypotensive effect, the advantages of non-inflammability and a good margin of sensory depression.

Total subarachnoid sympathetic block

Since its inception spinal block has been criticized for many reasons, but chiefly on account of its depressant effect on the circulation. Undoubtedly the hypotension induced by the method occasionally killed a patient, but most deaths might have been avoided by better understanding and management of the temporary derangement of cardiovascular dynamics associated with partial or total sympathetic paralysis. Much effort has been directed to devising means of preventing such hypotension or correcting it. In this connexion it may be submitted that the prophylactic vaso-

constriction produced by pressor d...
complications of spinal a...
Some observers, among t...
(1931), recognized the potential advantage to surgery of low blood pressure of non-haemorrhagic origin. Such recognition was at first *incidental* while total spinal block was being tried for operations on the upper part of the body, including the neck and head. Clinicians who employed an *orthodox block* restricted to the level of the fifth thoracic segment also noted that bleeding was *often subnormal* in the skin and in the splanchnic area, a feature probably due to giving a vasoconstrictor concurrently or

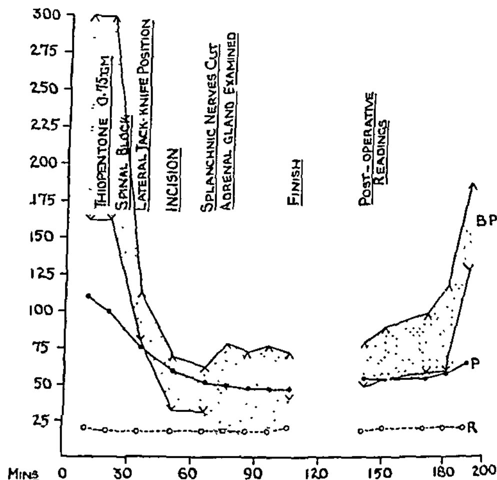


FIG. 77.—Female, aged 45 years Operation: thoraco-lumbar splanchnicectomy and sympathectomy. Pre-operative blood pressure 300/162. Anaesthesia: thiopentone 0 75 gramme; subarachnoid block, procaine 200 milligrams; nitrous oxide and oxygen. Lateral jack-knife position

to a psychologically increased output of adrenaline in patients allowed to remain conscious. In the technique to be described, that of Griffiths and Gillies (1948), ischaemia is achieved without vasoconstriction.

Technique and management

The patient is given an intravenous injection of 0·5–1·0 gramme of thiopentone sodium. Oxygen is then administered from a mask or through a tracheal tube; if necessary nitrous oxide may be added to maintain unconsciousness throughout operation. With the patient lying on one side the theca is tapped in the third lumbar space and 150–200 milligrams of procaine hydrochloride dissolved in 3–4 millilitres of cerebrospinal fluid are injected (Figs. 77 and 78). If the operation is likely to go

on for longer than an hour 1·5–2·2 millilitres of 0·5 per cent Nupercaine (7·5–11 milligrams) may be given instead of the short-acting procaine hydrochloride (Fig. 79). An alternative for a long case is the administration through an indwelling intrathecal catheter of adequate doses of procaine at intervals as required (Fig. 80). As soon as the injection has been made the patient is turned on his back and the table is tilted into a steep Trendelenburg position. The anaesthetic solution gravitates headwards: in doing so it involves an increasing number of spinal segments and becomes progressively more dilute. Ultimately it reaches the upper thoracic region but in a concentration sufficient to paralyse only the sympathetic and sensory fibres. Motor nerves are not significantly affected except in the lower segments closer to the point

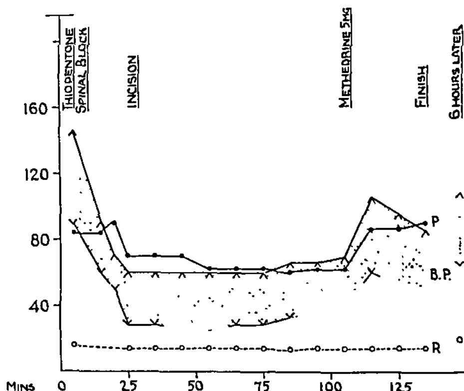


FIG 78—Female, aged 47 years Operation: radical mastectomy. Pre-operative blood pressure, 145/90 Anaesthesia thiopentone 0 5 gramme, subarachnoid block, procaine 150 milligrams; nitrous oxide and oxygen Horizontal supine position

of injection For complete paralysis of motor fibres a 2 per cent solution of procaine hydrochloride is necessary, whereas sympathetic fibres can be blocked by a 0 2 per cent solution as shown by Sarnoff and Arrowood (1946) in their work on differential spinal block. Sensory fibres are susceptible to concentrations of procaine in the order of 0 25–0 5 per cent.

While the patient is tilted his blood pressure falls steadily over a period of 5–10 minutes to a level of about 80 mm. Hg and usually becomes stabilized there. If the posture is now altered so that blood can pool in the dilated vascular bed of the legs there will be retardation of the venous return, a reduction in right auricular pressure and cardiac output and a further fall in blood pressure. Compensatory reflex responses to these changes cannot take place, as the entire sympathetic outflow has been paralysed but, if necessary, vasoconstriction may still be produced by means of a sympatheticomimetic agent such as desoxyephedrine (Methedrine). The pulse rate becomes slower than normal—a reaction which would appear to be activated through vagal

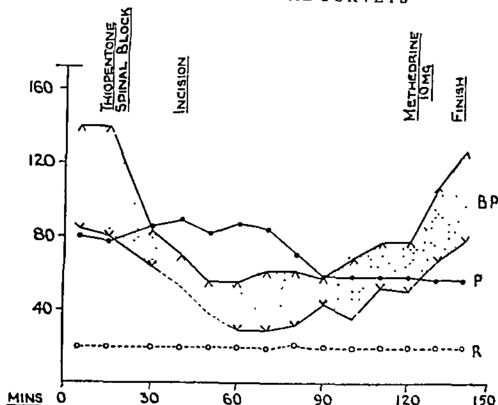


Fig. 79.—Male, aged 38 years Operation. partial gastrectomy. Pre-operative blood pressure 140/82 Anaesthesia. thiopentone 1 0 gramme; subarachnoid block, Nupercaine 2 2 millilitres (11 milligrams); nitrous oxide and oxygen Supine Trendelenburg position 10°.

THIOPENTONE (575 MG)
SPINAL BLOCK (150MG)
INCISION (0837)
PROCAINE (50MG)
BLOOD DRIP
PROCAINE (100MG)
EPHEDRINE (35MG)
EPHEDRINE I.M. (15MG)
FINISH (1137)
IN ROOM
NEXT DAY
160
120
80
40
P
B P
R.
MINS 0 50 100 150 200 250 300

Fig. 80.—Female, aged 28 years. Operation: pelvic exenteration Pre-operative blood pressure 144/94 Anaesthesia: thiopentone 0·575 gramme, subarachnoid block, 300 milligrams in divided doses injected through indwelling plastic catheter; nitrous oxide and oxygen. Supine Trendelenburg position 15°.

receptors in the great veins close to the heart. These nerve endings are affected by changes in venous pressure, and impulses from them pass along the right vagus to the cardio-inhibitory centre. As a result of this diastole is prolonged in keeping with the reduced venous return and adequate cardiac filling is maintained.

With this method of preventing excessive bleeding success depends on having the part to be operated upon at a higher level than the rest of the body. Thus it is best suited to operations in the region of the kidney, spleen or lower thorax, where the patient can be placed in the lateral, "half-opened jack-knife" position with his legs lowered to an appropriate extent while his head and thorax remain horizontal or just below that [illegible]

For upper abdominal surgery the patient should be kept horizontal, the reverse *Trendelenburg position is potentially dangerous and should be avoided where* hypotension has been induced by total sympathetic paralysis.

In cases where the legs can be lowered as described the blood pressure in the brachial artery may readily fall to 50 mm. Hg or less; sometimes it may even be unrecordable A very low level jeopardizes the patient's life or may lead to serious cardiovascular complications; it is also quite unnecessary as almost equally satisfactory operating conditions in respect to bleeding are provided when the systolic pressure is stabilized at the safe level of 70 mm. Hg.

The need for close observation of the hypotensive patient cannot be over-emphasized. While the pulse and blood pressure should be noted at short intervals the respiration is a constant visible indication of the patient's condition. This particular technique of spinal block should not cause respiratory paralysis or even embarrassment although involvement of the lower intercostal nerves is unavoidable. Breathing remains spontaneous because the analgesic solution becomes too dilute to affect the upper intercostals and the phrenic nerves. It is essential, however, to administer oxygen throughout the period of hypotension and assist respiration if pulmonary ventilation is deficient. Marked respiratory depression, when it occurs, is a sign of anoxia of the medulla and an urgent signal of circulatory inadequacy and impending failure Sometimes irregularities in rhythm and force of the pulse may be detected before any marked change in respiration, in which case the correct treatment is more obvious and is directed primarily towards aiding the circulation by measures to be described presently. As might be expected, a rapid simultaneous change in the patient's colour confirms the presence of profound cardiovascular depression. Such serious developments must and can be prevented by ensuring that the venous return and cardiac output are maintained at an adequate volume. Before the blood pressure falls to a dangerous level the flow of blood to the heart should be aided by raising the legs from the dependent position. This ought to suffice if done soon enough. If, however, the manoeuvre is not immediately effective an intravenous injection of a pressor drug must be given, even at the risk of raising the blood pressure too much and inviting critical comment from the operator.

The anaesthetist must also watch carefully the field of operation. In certain situations significant haemorrhage may take place despite hypotension and easy haemostasis As the vascular bed is completely paralysed it cannot adjust its capacity to the reduced volume of circulating blood in the normal physiological way and therefore immediate transfusion must be carried out. A pressor drug may be given as a temporary aid until the lost blood has been replaced.

It is advisable that the patient should remain unconscious until the operation has been completed. Sometimes the induction dose of thiopentone sodium lasts long enough but more often it does not. In the latter circumstance nitrous oxide and oxygen in equal parts can usually maintain a satisfactory light plane of unconsciousness.

The hypotensive patient does not require much anaesthetic, and the gr
must attend the administration of supplementary agents. Experience in t
has shown that the giving of an intravenous barbiturate to a patient in
tensive state, whether this be due to haemorrhage or sympathetic block,
with serious danger.

The duration of a high spinal block and the hypotension which accom
fairly constant and predictable; it varies only with the agent chosen and th
used. If the effects outlast the operation the same care must be given to t
afterwards as during operation. He must remain in a recovery room under
vision of the anaesthetist and, even if conscious, be kept on oxygen until
tensive state has passed. This recovery should be allowed to develop spon
without the use of a vasopressor unless, as rarely happens, this is necessar

Extradural block

Effects similar to those associated with subarachnoid block can be obtain
extradural injection of an analgesic drug. The latter procedure is technic
difficult and its results are less certain. Bromage (1951) has described a com
method of extradural block whereby analgesia, muscular relaxation and c
hypotension may be achieved with a satisfactory degree of effectiveness ar
This observer injects 30–50 millilitres of a mixture containing Nupercaine
cent), procaine (1·6 per cent) and adrenaline (0·0007 per cent), or alternati
caine (1·5 per cent) and adrenaline (0·0007 per cent) at a convenient point
the tenth thoracic and third lumbar vertebrae; he states that blocks with
limit at the third thoracic segment produce a fall in systolic pressure of 80–60

In contrast to subarachnoid injection there is no further dilution of the
solution, the concentration of which remains constant, and so the nerve roots
are affected uniformly. Care is necessary, therefore, to prevent paralysis c
intercostal and particularly the phrenic nerves. The variable capacity of t
dural space makes difficult the estimation of the quantity of analgesic to be
through an overdose, complete respiratory paralysis occurs, artificial ventilati
lungs must be continued until breathing is not only spontaneous but adequ

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General ganglionic blockade

The introduction to clinical practice of agents capable of blocking aut
ganglia and thus inducing vasodilatation and hypotension quickly followe
indirectly related experimental work of Barlow and Ing and Paton and
which has been summarized by Keele (1952). Their investigations concern
release of histamine by certain drugs, including the methonium compounds, t
to light the curare-like action of decamethonium (C10) and the hypotensive e
both pentamethonium (C5) and hexamethonium (C6). Organe, Paton *and*
(1949), in a study of the muscle-relaxant property of decamethonium iodide, su
the use of pentamethonium iodide as an antidote to the former on the basis c
evidence of antagonism *between the two drugs; at the same time they observ*
pentamethonium could cause postural hypotension. Following on this D
[illegible]

Larger series of cases covering trials of both pentamethonium and [illegible]

have been published by Enderby (1950) and Enderby and Pelmore (1951), and the convincing merit of this work stimulated the wide adoption of the technique.

According to Keele (1952), pentamethonium and hexamethonium are the most

ing effect of acetylcholine. This causes vasoconstrictor paralysis accompanied by arteriolar and venous dilatation, depression of compensatory cardiovascular reflexes

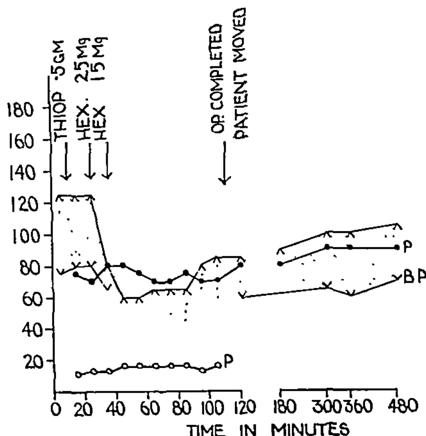


FIG 81 —Male, aged 43 years Operation arthrodesis of hip joint Pre-operative blood pressure 124/78 Anaesthesia thiopentone 0 5 gramme, nitrous oxide and oxygen supplemented by cyclopropane, hexamethonium 40 milligrams. Horizontal, semi-lateral position

and a basal degree of hypotension which may be modified by positioning of the patient.

General ganglionic blockage affects parasympathetic as well as sympathetic ganglia, and thus differs from subarachnoid and extradural nerve block in which only the preganglionic sympathetic fibres and the sacral parasympathetic outflow are paralysed. The autonomic ganglia are not equally depressed by the methonium drugs, those at the terminals of the vagal fibres in the abdominal viscera and the heart being less sensitive than the vasomotor ganglia. As might be expected, the clinical features vary from those of the other techniques discussed, and there are more side-effects associated with the complex pharmacological action of total autonomic paralysis. Thus with pentamethonium or hexamethonium the pulse rate may be accelerated, and occasionally gastro-intestinal ileus may develop post-operatively.

In practice it is usual before giving hexamethonium to arrange the already anaes-

The hypotensive patient does not require much anaesthetic, and the greatest care must attend the administration of supplementary agents. Experience in this matter has shown that the giving of an intravenous barbiturate to a patient in the hypotensive state, whether this be due to haemorrhage or sympathetic block, is fraught with serious danger.

The duration of a high spinal block and the hypotension which accompanies it is fairly constant and predictable; it varies only with the agent chosen and the quantity used. If the effects outlast the operation the same care must be given to the patient afterwards as during operation. He must remain in a recovery room under the supervision of the anaesthetist and, even if conscious, be kept on oxygen until the hypotensive state has passed. This recovery should be allowed to develop spontaneously without the use of a vasopressor unless, as rarely happens, this is necessary.

Extradural block

Effects similar to those associated with subarachnoid block can be obtained by the extradural injection of an analgesic drug. The latter procedure is technically more difficult and its results are less certain. Bromage (1951) has described a commendable method of extradural block whereby analgesia, muscular relaxation and controlled hypotension may be achieved with a satisfactory degree of effectiveness and safety. This observer injects 30–50 millilitres of a mixture containing Nupercaine (0·17 per cent), procaine (1·6 per cent) and adrenaline (0 0007 per cent), or alternatively xylocaine (1·5 per cent) and adrenaline (0·0007 per cent) at a convenient point between the tenth thoracic and third lumbar vertebrae; he states that blocks with an upper limit at the third thoracic segment produce a fall in systolic pressure of 80–60 mm. Hg.

In contrast to subarachnoid injection there is no further dilution of the analgesic solution, the concentration of which remains constant, and so the nerve roots involved are affected uniformly. Care is necessary, therefore, to prevent paralysis of all the intercostal and particularly the phrenic nerves. The variable capacity of the extradural space makes difficult the estimation of the quantity of analgesic to be given If, through an overdose, complete respiratory paralysis occurs, artificial ventilation of the lungs must be continued until breathing is not only spontaneous but adequately so

When a hypotensive effect alone is desired a weak solution of procaine (0·2 per cent) sufficient to affect only the sympathetic fibres may be used. Such a modification has a therapeutic application as shown by Lull and Hingson (1948) in the treatment of the hypertension of eclampsia, but in anaesthetic practice there is little point in making an extradural block unless to obtain all the advantages already mentioned.

General ganglionic blockade

The introduction to clinical practice of agents capable of blocking autonomic ganglia and thus inducing vasodilatation and hypotension quickly followed some indirectly related experimental work of Barlow and Ing and Paton and Zaimis which has been summarized by Keele (1952). Their investigations concerning the release of histamine by certain drugs, including the methonium compounds, brought to light the curare-like action of decamethonium (C10) and the hypotensive effect of both pentamethonium (C5) and hexamethonium (C6). Organe, Paton and Zaimis (1949), in a study of the muscle-relaxant property of decamethonium iodide, suggested the use of pentamethonium iodide as an antidote to the former on the basis of some evidence of antagonism between the two drugs; at the same time they observed that [illegible] Following on this Davison [illegible] ethonium [illegible] morrhage. [illegible] Larger series of cases covering trials of both pentamethonium and [illegible] ethonium

have been published by Enderby (1950) and Enderby and Pelmore (1951), and the convincing merit of this work stimulated the wide adoption of the technique.

According to Keele (1952), pentamethonium and hexamethonium are the most active autonomic blocking drugs known, and of the two hexamethonium is the more potent. The action is highly specific and confined to blocking transmission of impulses across the cells of the ganglia, presumably by raising their threshold to the depolarizing effect of acetylcholine. This causes vasoconstrictor paralysis accompanied by arteriolar and venous dilatation, depression of compensatory cardiovascular reflexes

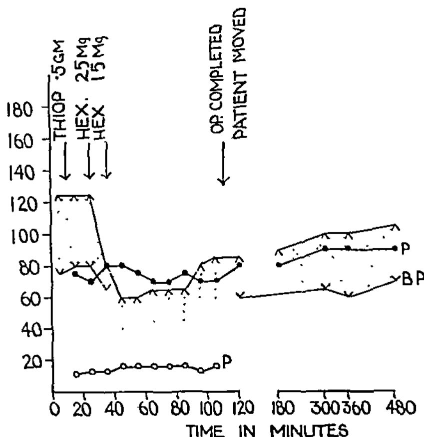


Fig. 81 [illegible]

and a basal degree of hypotension which may be modified by positioning of the patient

General ganglionic blockage affects parasympathetic as well as sympathetic ganglia, and thus differs from subarachnoid and extradural nerve block in which only the preganglionic sympathetic fibres and the sacral parasympathetic outflow are paralysed. The autonomic ganglia are not equally depressed by the methonium drugs, those at the terminals of the vagal fibres in the abdominal viscera and the heart being less sensitive than the vasomotor ganglia. As might be expected, the clinical features vary from those of the other techniques discussed, and there are more side-effects associated with the complex pharmacological action of total autonomic paralysis. Thus with pentamethonium or hexamethonium the pulse rate may be accelerated, and occasionally gastro-intestinal ileus may develop post-operatively.

In practice it is usual before giving hexamethonium to arrange the already anaes-

thetized patient in a position which without being inconvenient for the opera allow postural adjustments to be made by the anaesthetist. It is particularly d that the site of operation should be elevated and the patient's legs so placed tl can be lowered or raised in order to control the venous return and main optimal level of blood pressure. When it is not feasible to lower the legs by ing" the operating table it may be necessary to employ with caution a Trendelenburg tilt of about 10 degrees to ensure gravitational pooling. Ofte ever, marked ischaemia is obtained even with the patient horizontal in the prone or semi-lateral positions (Fig. 81).

The average initial intravenous dose of hexamethonium for a physically fit adult is 50 milligrams, but if its effect is unsatisfactory additional injections of quantities should be made. For elderly patients and those suffering from sclerosis or hypertension 20 milligrams are usually enough. The effective dosag particular individual is difficult to assess; the writer has seen a profound fall of pressure after 5 milligrams of hexamethonium, whereas other observers have re cases in which a total of 300 milligrams had to be given before a helpful de hypotension developed.

The duration of hypotension associated with the use of the methonium comp varies considerably and is somewhat unpredictable. These agents are elimina the kidneys, and their time of action probably depends largely on renal effic Delayed elimination and persistence of circulatory depression in the post-op period may lead to serious vascular complications unless the close minute-to-m supervision exercised throughout the operation is continued.

Management of the patient follows the same lines as when sympathetic block is employed. Proper ventilation and oxygenation are essential and an ade venous return must be maintained to ensure a cardiac output that will pr sufficient blood to the brain and myocardium. When signs of excessive circu depression appear, measures to reverse this such as have already been descri the previous section must be taken promptly.

The general effectiveness of the method has been assessed by Enderby and Pe (1951), who state that 85 per cent of patients can be controlled at systolic pre of 55–80 mm. Hg.

Hypotension and posture

With the exception of arteriotomy the several methods of planned hypote discussed depend on appropriate positioning of the patient for the determinati the ultimate level of blood pressure and its control. The prone posture with the lowered is the most extreme one likely to be used. When associated with genera vasodilatation this posture may produce dangerous circulatory depression, bec in such circumstances the venous return is considerably affected on account of greater anti-gravitational force that has to be overcome in the tributaries of inferior vena cava when the latter is at a high level. This factor must ... mind when a patient still in the hypotensi... ...ng transferred fr... ating table to bed; he should be moved wit... the safest way him gently into bed from the table, which ... is lifted he must not be turned from a ... prone ... a serious secondary fall of blood pressure ... sudden ch is dangerous where hypotension has been ... circulatory activity ... differentia... blood to

Hypotension and r...

Haemostasis in ... patient is that bleed after the ... show ...

general pallor of the tissues and must be dealt with meticulously; those that cannot be seen seal themselves off in Nature's own way. Sometimes, as may be noted on one of the charts (*see* Fig. 78), a test dose of desoxyephedrine is given before the closure in order to raise the blood pressure temporarily and thus make potential bleeders visible. Such a measure, though rarely necessary, is a sound precaution in operations on deeply situated structures in which bleeding points might be overlooked.

Contra-indications to Planned Hypotension

Enthusiasm for bloodless operations is understandable, but hypotensive methods should not be employed except to provide benefits for the patients to whom they are applied.

The main contra-indications concern the cardiovascular system. In patients with coronary sclerosis a reduction of peripheral resistance and of blood pressure carries a definite risk. Occasionally individuals with this disease have been subjected to a hypotensive technique without incident, possibly because the blood flow, although reduced, may still be enough for a heart whose work is less while the peripheral resistance is low.

Peripheral vessels with vascular degenerative changes and narrowing may not respond to paralysis of vasoconstrictors, and so an already precarious blood flow in a limb may virtually cease because of low blood pressure.

Lastly, any hypotensive technique is dangerous to patients whose blood volume is subnormal In discussing low pre-operative blood volume Nicholson and Jensen (1952) advise the pre-operative investigation of total blood-volume by the Evans blue-dye (T-1824) method in underweight poor risk cases, even if the haemoglobin, haematocrit and plasma protein determinations are within normal limits. This would appear to be a commendable precaution in cases of doubtful risk in which a hypotensive technique is considered essential in the interest of the patient.

CONCLUSION

Anaesthetic practice has reached a stage where most of the traditional problems associated with it have been solved, particularly its long-standing fundamental disadvantage of toxicity. General anaesthesia, exhibited to its fullest range as too often it had to be before the introduction of modern adjuvants, was in varying degree a pathological state which for a time helped the development of surgery but later became more and more of a hindrance as the surgical horizon extended. Modern methods based on what has been termed "physiological trespass" (Gillies, 1952) are relatively non-toxic and readily reversible, merits which bring higher standards of efficiency and safety than have existed heretofore.

(*See also British Surgical Practice* Anaesthesia—General, Vol 1, page 205, S Key 26, Anaesthesia—Regional, Vol. 1, page 236, S Key 28, *and* Anaesthesia—Spinal, Vol 1, page 245, S Key 29)

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BLOOD PRESSURE–
TREATMENT OF HYPERTENSION

By G. W. PICKERING, M.B (Cantab.), M.D.(Ghent), F.R.C.P.
Professor of Medicine, University of London

GENERAL CONSIDERATIONS

The difficulty in defining hypertension arises from three causes; in any individual the arterial pressure is not fixed but varies with circumstances; in any group of individuals of the same age, and selected at random, the blood pressure measured under similar conditions shows a distribution curve of the usual random type; and finally in groups of individuals so selected the mean arterial pressure rises with age.

The arterial pressure measured in the out-patient department or the consulting room is what may be called the casual blood pressure. It is affected by a number of factors, such as apprehension, which vary from one individual to another If the patient is kept in bed and if the arterial pressure is repeatedly measured while the patient is quiet and relaxed, the pressure reaches a level about which it oscillates only slightly; this level is termed the basal blood pressure Which of these values is to be adopted in defining hypertension? To use either or both is clearly an approximation, since the average adult spends only 8–10 hours a day under basal conditions, and the variations in pressure during the wear and tear of daily life are unknown. The gap between casual and basal blood pressures is increased in essential hypertension (Smirk, 1947)

In Alvarez's (1923) figures for systolic pressure in 1,216 male Californian undergraduates aged 18 years, the mean value was 130·0 millimetres of mercury, the extremes were 85 and 219 and over two-thirds of the observations lay between 116 and 143 millimetres of mercury. These were casual blood pressures.

The relationship of casual pressure to age has in the past been completely obscured by insurance statistics from which individuals showing pressures above a certain value have been excluded. The investigations of Alvarez (1923), Master, Goldstein and Walters (1951) and of others have shown that mean figures increase with age. In my own department, measurements by Hamilton and Sowry (unpublished) on 1,000 unselected out-patients attending clinics, such as orthopaedic, skin, fracture and varicose vein clinics in which no association with hypertension is known, have shown mean values rising from 115 mm. Hg (standard error (S E.) 1·8) systolic and 71·3 mm. Hg (S E. 1 2) diastolic in the second decade to 180 7 mm Hg (S.E. 4 0) systolic and 99·3 mm. Hg (S E. 2·3) diastolic in the eighth decade. There is thus substance for the old adage that the expected systolic blood pressure is 100 plus the patient's age. Arterial pressure tends to rise with age, just as hair tends to grey Whether either is normal or abnormal is beyond the scope of this paper.

semester, the greater the incidence of complications for the mother and the less th[illegible] expectation of a living child. From the point of view of therapy we have to conside[illegible] the order of benefit that any form of therapy may confer and the demands made o[illegible] the patient in time, anxiety, discomfort or alteration in way of life.

ESSENTIAL HYPERTENSION

Essential hypertension is diagnosed by exclusion. It comprises a group in which hypertension is the earliest and, for much of the course, the dominant finding and in which the characteristic manifestations of certain other diseases are absent. It is therefore still uncertain as to whether or not it is a single entity. Evidence has been accumulating to show that two factors are chiefly responsible for elevated arterial pressure, age and inheritance, and recent work of our own confirms this statement. The mechanism whereby arterial pressure becomes raised is not certain, but it is very probably due to arterial and arteriolar vasoconstriction rather equally distributed over the territories of the systemic circuit (Pickering, 1950).

The agent causing the vasoconstriction is unknown, but over-activity of the sympathetic nerves is not a sufficient explanation. Such being the state of present knowledge concerning causation and mechanism, it is not surprising that nothing is known to be effective in preventing the condition, and therapeutic measures are at best palliative. Since, under any definition of hypertension, the condition is common, its course is usually prolonged, and all the more effective therapeutic measures are irksome or involve major surgery, an appreciation of the place and scope of treatment implies a knowledge of the course and prognosis of the malady.

[illegible] are obscure. Our observations on blood [illegible] is to [illegible] n in those without. Perera (1948), defining hypertensive vascular disease as a condition characterized by repeated readings of diastolic pressure over 90 mm. Hg, and searching the records of the clinic at the Presbyterian Hospital, New York, concluded that it always began before 48 and usually before 40 years of age.

In the later stages, as Volhard and Fahr (1914) pointed out, the disease follows one of two courses, benign or malignant. In the benign type the patient's condition often remains unaltered over many years, patients usually seek advice in the sixth decade or later, diastolic pressure is usually under 130 (basal), the eyegrounds show no retinitis or the type described by Foster Moore (1917) as arteriosclerotic retinitis, and death is due to cardiac failure in about half the number of cases, intercurrent disease in about a third of the number and cerebral vascular accidents in the remainder. In the malignant form the patient is usually younger, the diastolic pressure is nearly always above 130 mm. Hg, and the course is rapidly downhill to death in uraemia in about 1 year from the onset which is heralded by albuminuric retinitis (neuro-hypertensive retinopathy, Grade IV retinitis). Albuminuric retinitis, in which bilateral papilloedema is invariable, large ill-defined exudates the rule and a macular star common, is thus clinically the *sine qua non* of malignant hypertension. Arteriolar necroses which occur in the kidney, gut, abdominal organs, heart and brain, roughly in that order, are the *sine qua non* histologically, and it is the progressive development of these lesions, [illegible] that determines the course of [illegible] ere is now abundant evidence [illegible] ects of a grossly raised intra- [illegible] treatment is simple; it is [illegible] ever means, retinitis clears and life is prolonged.

The problem of treating benign hypertension is much more difficult; this is chiefly because the exact part played by the intensity of hypertension in determining the course is uncertain, and because the nature of the initial fault is unknown.

Thus it has been quite generally assumed that cardiac failure, the chief cause of death, is due to myocardial ischaemia. Now there is a high incidence, and perhaps an unusually high incidence, of hypertension in ischaemic heart disease. Cassidy (1946) found that in his cases of angina pectoris and myocardial infarction, 22 per cent had pressures over 200/120, 34 per cent had pressures over 160/100 and under 200/120, and 44 per cent had pressures under 160/100. Harrison and Wood (1949), analysing 189 cases of ischaemic and hypertensive heart disease, examined *post mortem* at Hammersmith Hospital, found 30 per cent were ischaemic, 55 per cent were hypertensive and 15 per cent were mixed; the ischaemic cases were so classified if they had had angina or myocardial infarction, irrespective of arterial pressure. More than half the hypertensive group had died from non-cardiac causes. They found that "the typical hypertensive heart has smooth distended coronary arteries", and in fact they were unable to find why these hearts should be liable to develop failure. While hypertension may exaggerate the tendency, recent work (Gofman, 1951) makes more probable the old view that atheroma is largely a metabolic fault, due to a disturbance in lipoid metabolism. It is clear therefore that the exact part played by the level of arterial pressure in any individual in causing heart failure, whether of the ischaemic type or not, is still uncertain.

Nor is the part played by hypertension in determining cerebral vascular accidents quite clear. Cerebral thrombosis is much the commoner and, like coronary thrombosis, probably occurs on a pre-existing atheromatous lesion. Cerebral haemorrhage almost certainly occurs through a fault congenital or acquired in a cerebral artery and here the level of hypertension may be expected to be a factor

Study of the living, however, shows that the level of arterial pressure does influence prognosis. Life insurance figures show that the level of systolic and diastolic pressures during the second, third and fourth decades are, in a general way, inversely related to expectation of life (Dublin, Lotka and Spiegelman, 1949). Burgess (1948), following up cases in which the arterial pressure was over 180/100 and who survived 8 or more years, found no difference in expectation of life between those whose systolic pressures at times exceeded 250 mm. Hg and those whose pressures did not; but there was a slightly greater deficit of expectation of life in those with diastolic pressures over 120 mm. Hg. as compared with those whose [illegible]

[illegible]

that exist between the results of different workers who have followed groups of patients with hypertension for long periods, for the survival rate varies from 9 per cent in 4–9-year periods (the Mayo Clinic, Keith, Wagener and Barker, 1939) to 83 per cent in 12-year periods (the Presbyterian Hospital, New York, Perera, 1948). Since all these patients received symptomatic treatment it is probable that the disparities reflect differences in the average severity of the malady. An attempt to grade patients was first made by Keith, Wagener and Barker (1939) who used the retinal vessels and associated retinal lesions as their chief guides. They were followed by Palmer, Loofbourow and Doering (1948), Hammerström and Bechgaard (1950) and Smithwick (1951)

None of these series gives an accurate picture of the course and prognosis in all patients whose blood pressures are raised above the normal in a large and representative sample of the population. Naturally enough, Smithwick's series and those of the Mayo Clinic contain relatively large numbers of more severely affected patients. But it is probable that by far the majority in an unselected series would belong to the less severely affected grades.

Many measures have been tried in the treatment of hypertension. Some are so tiresome and have achieved so little success that they are either abandoned or are in the process of being so. These measures include thiocyanates, the veratrum group of compounds, the hydrogenated ergot preparations, dibenamine priscol and tetraethyl ammonium bromide. The measures that deserve more notice are common sense and symptomatic treatment, pyrogen treatment, low-salt diets, treatment with hexamethonium and pentamethonium compounds and sympathectomy. These may now be considered in detail.

Common sense and symptomatic treatment

No doctor with a representative experience of essential hypertension can fail to be impressed with the large number of patients who lead active and useful lives despite the presence of mild, moderate or gross degrees of hypertension. To subject such *patients to major surgery or to interfere in the even tenor of their lives by rigorous* treatment would be justifiable only if we had a remedy which could be guaranteed to increase their comfort or very materially to prolong their active lives, and, as will be seen, this is not the case. Commonly such patients suffer not so much from hypertension as from the fear of it, a fear engendered by the knowledge that they have hypertension, by over-dramatized articles in the press (for example, Hypertension—Number One Killer) and by doubts of their medical attendants as to the advisability of major surgery or other therapy. As in any chronic disease, the first duty of the doctor is to accept responsibility for the disease, to give the patient confidence, and to note and deal with any new developments that arise. The doctor should always be on his guard against frightening his patients, and in no disease more so than in hypertension.

This applies to all cases and in the milder and older subjects it may be all that is [illegible] the reduction of weight by diet if [illegible]

[illegible] at a time keeps some patients comfortable.

Pyrogens

Volhard and Fahr (1914) pointed out years ago that *fever would abolish hypertension* [illegible] for anti-renin Page and his colleagues observed falls of pressure wi[illegible]

or any [illegible]

effects [illegible]

regular fever and the least side-effects. He gives doses sufficient to produce [illegible] 101–103° daily for 5 or 6 days weekly to patients with malignant hypertension who have more than 50 per cent of normal renal function. In successful cases the *blood* pressure falls, the eyegrounds clear, haematuria and proteinuria diminish. After 6 weeks to 3 months the treatment is discontinued and though the pressure rises again the deterioriation apparently ceases, *at least for* some years. Of 19 cases of malignant [illegible] after ceasing treatment, [illegible] and 5 died [illegible]

This is quite an impressive record to be set on against the [illegible] side-effects [illegible] and the long hospitalization necessary. Others who have used typhoid [illegible] prob- [illegible] re

Low salt diet

Twenty years ago, severe restriction of salt intake was a common practice in German and French clinics for the treatment of hypertension.

Allen and Sherrill (1922) showed in the United States of America the effectiveness of a low salt diet in reducing arterial pressure. Renewed interest has been awakened in the subject by the rice-fruit diet of Kempner (1948), who arrived at his diet as the result of experiment on kidney slices by a mental process that is not accessible to me. The rice-fruit diet contains 20 grammes protein, 5 grammes fat, 200 milligrams chlorine and 150 milligrams sodium and provides 2,000 calories per day. Kempner recommends that the diet may have to be continued indefinitely but that, provided the clinical state and the arterial pressure allow, additions may be made of non-leguminous vegetables, [illegible] added In 1948 Kempner recorded the results in 500 patients treated by this diet for periods of from 4 to 898 days. The diet was ineffective in 178 patients, of whom 26 were in a critical condition and died early in the treatment. The average fall of blood pressure in the successful patients was 47 mm. Hg systolic and 21 mm. Hg diastolic. Papilloedema disappeared completely in 17, partially in 5 and remained unchanged in 1 patient. In Great Britain the Medical Research Council committee (1950) confirmed these findings in a general way on 36 patients in whom the average fall of blood pressure was 55 mm. Hg systolic and 26 mm. Hg. diastolic. The rice-fruit diet, or apparently any diet containing less than 250 milligrams of salt per day, thus justifies its claim as effective therapy in prolonging life in malignant hypertension, and in reducing arterial pressure and relieving headache in benign hypertension. It is accepted therapy for cardiac failure of whatever cause. To what extent it may prolong life in any but the most severe forms of benign hypertension is still unknown. There are two chief drawbacks to this treatment. First it is dangerous in cases with impaired renal function in which it may precipitate uraemia. Secondly it is insipid, unappetizing and monotonous, and demands great care in preparation, for if salt rises above 250 milligrams per day the effect in many instances is lost. As a diet for a member of a substantial household with minimal domestic help it is quite impracticable. As such its use will be limited to those who can afford the time, and to whom the monotony of the diet is not such as to make life scarcely worth living.

Hexamethonium and pentamethonium salts

The original investigations on these substances were by Barlow and Ing (1948) and Paton and Zaimis (1949). Paton and his colleagues have shown (Paton, 1951) that they act on sympathetic and parasympathetic ganglia, probably combining with the receptive substance on the postganglionic nerve endings, thus preventing synaptic transmission in these ganglia. In larger doses they paralyse other effects transmitted by acetylcholine, such as motor nerve stimulation. Arnold and Rosenheim (1949) showed that these substances, injected intramuscularly, had a greater depressor effect in patients with essential hypertension than in normal subjects, and that in both the assumption of the erect position produced a profound fall of pressure during the action of the drug. Arnold, Rosenheim and Goetz (1949) and Burt and Graham (1950) observed increased skin blood flow, as is to be expected, but the former found that some increase occurred also in the sympathectomized limb. The action of these substances on man is still therefore incompletely understood.

The treatment of essential hypertension by these substances is still in an exploratory stage. References to the early papers will be found in the work of Smirk and Alstad (1951), who have the longest and the most extensive experience of the drugs. In general, hexamethonium is preferred to pentamethonium. The compound at present

supplied is, unfortunately, the bromide, since bromide rashes and the cerebral manifestations of bromism, occurring especially when the drug is used by mouth in conjunction with a low salt diet, are complications thus needlessly encountered. Steps are being taken to supply other salts which will replace the bromide.

Published results on the effectiveness of hexamethonium in hypertension differ widely. Smirk and Alstad (1951) have treated 53 patients for 2–14 months, selecting those with the highest pressures and potentially reversible manifestations of hypertension. They found similar falls of blood pressure following injection of 15 milligrams in essential hypertension, malignant hypertension, renal hypertension and hypertension after sympathectomy. Because alimentary absorption is capricious the injection is given subcutaneously, beginning with 15 milligrams and increasing the dose as tolerance develops so that the desired fall of pressure is obtained; the final dose may vary from 100 to 250 milligrams. The trough of the pressure fall is reached about half an hour after the smaller, and about an hour after the larger, doses. The fall of pressure lasts some 4–8 hours, and is improved by standing or by sitting and by the use of a salt-free diet. They conclude that nearly all hypertensive patients can have their pressure controlled with these drugs, except those with grossly impaired renal function. Smirk and Alstad, in fact, consider that hexamethonium is more dependable and generally more effective than sympathectomy or a salt-free diet. They have observed relief of headache and breathlessness; no definite decrease in cardiac size but a change in the electrocardiogram towards normal. They treated 12 cases with papilloedema and state: "It has been clear to all observers that in all patients with papilloedema treated for two months or more, there has been either disappearance or a substantial diminution of the abnormality."

At the other extreme is the experience of Locket, Swann and Grieve (1951) who have treated 46 patients by intramuscular injection for 2 weeks and then orally. "In every case the methonium compounds were hardly more effective in lowering blood pressure than the bed rest period." They attributed the subjective benefit to the bromide ion.

Our own experience, like that of Mackey and Shaw (1951), is intermediate, about one-half of patients responding well, or moderately, and one-half abandoning treatment. In our experience treatment by mouth can be effective, but it is highly erratic in some patients. Milne and Oleesky (1951) showed that nearly all the hexamethonium injected intramuscularly is excreted in the urine, but only a fraction, which may vary from 3 per cent to 13 per cent from one day to another, of that given by mouth. Absorption from the gut is thus irregular, and dangerously large falls of pressure may occur unpredictably in patients receiving large oral doses. Subcutaneous injection is more reliable but has to be given 6 or 8 hourly, thus 4 or 3 times a day: beginning with [illegible] dosage is increased as tolerance heightens, [illegible] 120 mm. Hg in the horizontal position. The [illegible] milligrams. In 2 of 4 cases of maligant hypertension, the eyegrounds and urine cleared with the maintained fall of pressure; 1 case developed bromism and treatment had to be discontinued; the remaining case in an advanced state died. In other patients gallop rhythm and pulsus alternans have disappeared and cardiac asthma has been controlled.

But the treatment has grave defects that must be remedied if it is to pass as satisfactory therapy for a common disease of long course. The present preparations produce so brief an effect that injections have to be frequent. For an hour or so after each [illegible] patient may have to rest, otherwise he feels giddy on standing and may [illegible] nodation; his mouth is dry, [illegible] ninent in some patients that effective therapy is impossible and it is wise to adopt an alternative. But in nearly all patients they impose a restriction that may prove intolerable to a busy housewife or a working man. When these defects are considered in terms not of weeks or months but

of years they show clearly the limitations of hexamethonium as we now know it. With the introduction of some preparation with a longer and a more uniform action the position would be transformed. For the time being it seems probable that hexamethonium will find its chief place as a therapeutic weapon in the immediate treatment of malignant hypertension. It should certainly be tried in all cases of malignant hypertension in which sympathectomy has failed, as it offers the only real hope to such patients.

Sympathectomy

Sympathectomy is the most thoroughly tried major remedy for hypertension and still one of the most controversial. Immediately after the bilateral operation there is usually a severe fall in pressure, but this lasts a varying time. In a few the pressure quickly regains its previous level, in others it remains relatively normal persistently and in most it slowly rises to, or nearly to, its pre-operative value. Surgeons have tended to attribute these recurrences of hypertension to over-activity of the remaining sympathetic nerves, and, striving always for perfection, have successively extended the operation. Thus the earlier operations of Peet above the diaphragm and of Adson below it were combined by Smithwick, while Grimson ablates the whole sympathetic chain from Th.2 to L.3. It is not clear that the results in terms of comfort or longevity are much better with the larger than the smaller operations, while the persistence of hypertension in many cases after a very nearly complete sympathectomy makes it highly unlikely that in them, at least, hypertension was due to sympathetic over-activity.

The disadvantages of sympathectomy are plain. The actual mortality in the best clinics is small, 3 per cent or less. But not everyone cares to part with a large part of his anatomy for all time. In all patients with the more extensive sympathectomies, faintness and palpitations are common on getting up quickly or standing any length of time, for the blood pressure falls and the pulse quickens. Similar phenomena may occur on exercise. These effects may be lessened by leg bandages and a corset and in [illegible]

but not impotent in operations involving the lumbar ganglia. In some cases, Raynaud's phenomenon occurs in the fingers for the first time, or having previously occurred, becomes more severe.

The assets of the operation are also clear. In a proportion of cases of malignant hypertension, whether this develops from the benign type or is grafted on pyelonephritis, chronic nephritis or, less certainly, other lesions, there is a good fall of pressure, the eyegrounds clear, urinary abnormalities regress and life is prolonged. In others the disease progresses on its relentless course. The proportion of success varies but is higher the earlier the intervention in the course of the malady, and the younger the patient. In benign hypertension there is nearly always relief of headache and frequently of giddiness, and, less certainly, of cardiac failure. Recently Hammerström and Bechgaard (1950) and Smithwick (1951) have published very careful analyses of cases treated medically and by sympathectomy which show that the operation has significantly improved the expectation of life. Hammerström and Bechgaard collected 251 cases operated on at the Serafimer Hospital, Stockholm, and followed up for 2–8 years, and 435 non-operated controls, selected by the same criteria as the operated cases, from 130,000 records of various Copenhagen Hospitals and St. Erik's Hospital, Stockholm. They divided their cases as follows: group 1, symptomless; group 2, with symptoms but without general enlargement of the heart; group 3, with cardiac enlargement, cerebral insults or constant albuminuria; group 4, with retinal exudates and papillary protusion. There were no operated cases in group 1, and in group 2 the

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mortality in the non-operated cases was low enough to require longer observation to establish a significant difference. But in groups 3 and 4, there was a considerably better prognosis in the operated group in both males and females, the difference being statistically significant in group 4. Unfortunately there is a considerable age difference in the two series, the average being 43 years in the operated and 49·6 years in non-operated, and while these may be offset by the higher pressures in the operated group, strict comparison is difficult.

Smithwick has compared the mortality rates in his very extensive series of sympathectomies with those of Keith, Wagener and Barker (1939), and of Palmer, Loofbourow and Doering (1948), employing their classifications, the results being strikingly in favour of the sympathectomized cases. Impressed by the fallacies of selection, he has also compared the mortality rates in his operated cases with those of cases referred to him but not operated on, using a system of grouping on the usual lines but more complex and more comprehensive. This also shows a very striking difference in favour of sympathectomy. Even here, however, one possible source of error does not seem to have been finally ruled out. What factor determined why some patients were not subjected to surgery, and can this factor have determined the difference in survival rates in the two groups?

General comment

I [illegible]

sympathectomy. *Of these hexamethonium and sympathectomy seem to have the* widest application. Preliminary figures suggest that hexamethonium in adequate doses is more certain to relieve malignant hypertension than sympathectomy. If this is substantiated by subsequent experience, hexamethonium becomes the treatment of choice for this condition. When, however, prognosis is not so certainly bad as in malignant hypertension, when treatment is less urgent and when a long-term result is desirable, the position would seem more open. If it is decided that major therapy is necessary, those to whom daily injections for an unknown period are not to be contemplated will choose surgery, and those opposed to surgery will choose hexamethonium. For the larger group of little prejudice, the physician or surgeon for the time being will exercise his preference. *The important point yet to be established* is to what extent either or both of these measures prolong life and it is doubtful whether this can be answered with complete finality until a team selects a series as suitable for therapy and subjects one-half chosen at random to the measure, leaving the other half as a control. If relief of symptoms is all that is required, the common-sense measures backed by periodic venesections should be tried before subjecting the patient to anything more drastic.

TREATMENT OF SOME DISEASES ASSOCIATED WITH HYPERTENSION

Glomerulo-nephritis is still a disease of uncertain causation which is not known to respond with certainty to any specific therapy. The cause of hypertension is also unknown, and, though it is regarded as renal in origin, there is no proof that this is so. In the chronic form of glomerulo-nephritis, hypertension may be severe enough to require treatment, and it would appear that it can respond to such measures as sympathectomy no less well than essential hypertension.

Coarctation of the aorta now becomes a condition that can be successfully treated *surgically, preferably in childhood or adolescence*, thanks to Craaford's pioneer work.

Cushing's syndrome due to adrenal cortical tumours can be successfully treated by excision of the tumour when this is benign, but when this is malignant, as in a

recent case of my own, the symptoms, including hypertension, may recur with the growth of metastases. In pituitary tumours, treatment by irradiation is not in the author's experience very satisfactory and symptomatic treatment of hypertension may be necessary.

Phaeochromocytoma

Phaeochromocytoma has received more notice in recent years because of the realization that *nor*-adrenaline is as important, or more important, than adrenaline as an adrenergic substance, and because it appears to be the chief constituent of these tumours. Like adrenaline, *nor*-adrenaline blanches the skin; unlike adrenaline, it raises diastolic arterial pressure and produces no increase in cardiac output in small doses (Goldenberg and his colleagues, 1948, Barcroft and Konzett, 1949; Barnett and his colleagues, 1950).

Blanching of the skin is in fact one of the chief features of the paroxysms of hypertension which are so characteristic a feature of this disease, and provides the most important diagnostic feature of attacks of palpitations, anxiety, sweating, thoracic and abdominal discomfort or pain and breathlessness that may terminate in acute pulmonary oedema. More difficult to diagnose are cases in which hypertension is persistent and in which such attacks are absent. A variety of tests have been devised to diagnose phaeochromocytoma: histamine intravenously may precipitate an attack; piperoxane may reduce arterial pressure. These tests are not completely reliable and may be dangerous. A simple test that has proved positive in the only three cases of phaeochromocytoma in which it has been tried is that the blood flow through the hand when the other arm is immersed in hot water is reduced as compared with the normal (Pickering, 1936, Barnett and his colleagues, 1950). The best available test would seem to be the assay of *nor*-adrenaline and adrenaline in the urine (Engel and von Euler, 1950), for the excretion of these substances is greatly increased in phaeochromocytoma.

A phaeochromocytoma is best located by the appearance of a solid tumour near the kidney on plain films or pyelography or after air insufflation. But the tumour may arise from other chromaffin tissue and may be found only at exploratory laparotomy, or during operation on the sympathetic chain During operation, very large rises of blood pressure are common when the tumour is handled and may precipitate fatal pulmonary oedema. Extreme care in handling the tumour is thus necessary. Atropine should not be given pre-operatively, as this may greatly enhance the rise of pressure. When the last vessel leading from the tumour has been clamped, the pressure falls precipitously and intravenous infusion of *nor*-adrenaline at the rate of 20–40 micrograms per minute may be necessary to prevent dangerous hypotension.

Unilateral pyelonephritis

Pyelonephritis is a focal chronic inflammatory lesion of the kidney, often complicating anatomical abnormalities of the pelvis and ureter such as stone and hydronephrosis. It is thought to be due to an invasion of the kidney by *Escherichia coli*, but in the chronic form, in the author's experience, positive urine cultures are intermittent and the disease is in general not susceptible to permanent arrest by antibiotics. Chronic pyelonephritis is sometimes accompanied by hypertension, sometimes not, the feature [illegible]

fortune that is conferred on the patient, these successful operations present the only unequivocal evidence that hypertension in man is due to the operation of a renal mechanism. It is natural then that since the first description of a successful case by

Butler (1937), there has been a spate of case reports mostly single and mostly successful. And it is not surprising that these case reports give a rather distorted view of the efficacy of the operation. Thus in 1947 Langley and Platt summarized 93 cases published to that date, of which 47 were successes, 5 were partial successes, 28 were failures and 13 doubtful. They had themselves observed one successful case previously published and 10 cases reported for the first time, of which one was a partial success and 9 were failures. Heptinstall and Pickering (unpublished) have collected the results of 11 cases seen in the past 11 years and followed for periods up to 10 years, in each of which one kidney was removed for hypertension. Hypertension occurred some years after ligation of an aberrant renal artery in 2 patients, pulmonary embolus being fatal to one: the other had a good fall of pressure persisting for over 10 years. In both these patients the kidney showed hydronephrosis, pyelonephritis and atrophy of the pole supplied by the ligated artery. In one patient one kidney was tuberculous; hypertension was not affected by nephrectomy. Three patients had bilateral pyelonephritis and hypertension, which was not reduced by nephrectomy; 5 patients apparently had unilateral pyelonephritis; nephrectomy did not affect hypertension in 2, reduced it slightly in one, and dramatically in 2, the effect persisting at least 5 and 10 years.

Pyelonephritis is by no means easy to diagnose clinically and many morbid anatomists in Great Britain seem to be unaware of its existence. In these unilateral cases the disease is usually symptomless, or there may have been attacks of renal pain. Frequency, dysuria and fever are common in bilateral cases. Unilateral pyelonephritis is therefore often detected by pyelography when one kidney will be found not to excrete, or to excrete very poorly into an abnormal pelvis and calyces. Since dye may not be seen in films of a perfectly normal kidney, it is always necessary to confirm disease by repeating the intravenous, and carrying out a retrograde, pyelogram. With the ureters catheterized urine should be obtained from both kidneys so that organisms, albumin and casts may be looked for. Evidence of bilateral pyelonephritis would seem to contra-indicate nephrectomy, for it is unlikely to relieve hypertension; so does impaired renal function. Hypertension in the early malignant phase does not contraindicate, provided the disease is unilateral.

Hypertension in the early malignant phase, in which nephrectomy has failed or is contra-indicated, requires treatment to reduce hypertension. In the author's experience, removal of the whole of one and three-quarters of the other adrenal has produced a fall of pressure sufficient to enable the malignant phase to be overcome in two cases not affected by nephrectomy; the same measure plus infra-diaphragmatic sympathectomy was effective in a third in which the kidney was not excised. These three patients are all symptomless, though all have hypertension five years after the operation. Substitution therapy and salt are given before and after the second adrenalectomy as for an Addisonian crisis and omitted after a week, provided serum electrolytes are normal.

Adrenalectomy has not proved effective in malignant hypertension in adults.

(*See also British Surgical Practice* Blood Pressure: High and Low, Vol. 2, page 189, S. Key 61.)

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BRAIN–PRE-FRONTAL LEUCOTOMY

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and
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INTRODUCTION

We have no doubt that pre-frontal leucotomy has a place in the treatment of psychiatric disorders. We propose, in this article, to describe the operation and the indications for it.

DEVELOPMENT OF THE OPERATION

Egas Moniz, Professor of Neurology in the University of Lisbon, conceived that it might be possible to alter incorrigible delusions by disorganizing the anatomical structures which sub-served their formation, and in 1935 he tested the value of this idea by destroying small areas in the frontal lobes of chronically insane patients by the injection of alcohol. The results were not what was expected, for although some of the patients were improved, the delusions from which they suffered remained essentially unchanged. The improvement lay in the development of a greater emotional stability, so that the patients tolerated the symptoms better and therefore experienced less distress. The results were thus sufficiently encouraging to be pursued further.

Later developments came largely from the Americans, Freeman and Watts (1942), who through trial and error devised what they considered to be the best technique, namely section of the centrum ovale in the plane of the coronal suture. In this operation the fibres divided are mainly thalamo-frontal and arise mainly from the dorsal medial nucleus of the thalamus, so that section is followed by degeneration of the latter. It is supposed that this nuclear degeneration is related to the emotional changes that occur after operation.

This, the standard Freeman and Watts operation, is not done under direct vision, and post-mortem studies show that there is in fact a wide variation in the site and extent of the section, even in cases operated on by the same surgeon. The point of entry of the leucotome can vary by as much as 2 centimetres and the amount of white matter cut can be as little as 10 per cent of that which is intended. These variations are due to the great differences in the topography of individual skulls and their contents, and there is also evidence that the instrument may push aside the fibres instead of dividing them, so that its excursion does not necessarily produce a comparable cut.

Various attempts have been made to overcome the difficulties inherent in a blind operation, and surgical excursions have also been made into the temporal lobes, the hippocampus and the cingulate gyrus. The principle underlying all operations is, however, that of interference with thalamo-cortical projections.

TECHNIQUES

This is no place to go into the details of surgical technique but the main operations that have been proposed or are practised are as follows.

(1) *The standard operation* of Freeman and Watts. This is a blind procedure in which the leucotome is introduced through trephine holes in the skull on each side at a point 5–6 centimetres above the zygoma and 3 centimetres behind the lateral margin of the orbit, and is then pivoted up and down in the expectation of dividing the fibres

of the centrum ovale in the plane of the coronal suture, that is just in front of the anterior horn of the lateral ventricle.

(2) Various modifications of this essential plan have been tried with varying degrees of success, for example section of the lower fibres only, the instrument having been passed through only half its normal excursion.

(3) Open operations have been devised by Lyerly (1938) and by Poppen (1948), and unilateral lobectomy has also been advocated by some as being a cleaner and more controlled procedure.

(4) As an alternative, cortical undercutting under direct vision has been developed by Scoville (1949) and independently by McKissock (1951).

(5) An operation on a similar basis but with a different approach was devised by Freeman (1948) in which a pointed instrument is introduced through the roof of the orbit and is pivoted from side to side.

(6) Gyrectomy, also known as topectomy, has been pursued by Penfield (1948) and by Pool (1949) and consists of cortical excision of various areas, especially Brodman's areas 9 and 10, instead of sub-cortical section

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selected areas by electro-coagulation. This is referred to as "thalamotomy".

POST-OPERATIVE CARE

The problems of post-operative care can be most clearly seen after the Freeman and Watts standard operation, but the same problems occur to varying extents after all the others.

After the standard operation the patients are in a flat, torpid condition and require every nursing attention. They are often doubly incontinent for a short period and may need to be spoon-fed Vomiting is not infrequent and evidence of increased intra-cranial pressure, due to bleeding, must be carefully looked for. In our opinion, all patients should receive phenobarbitone, ½ grain twice daily, as a prophylactic against epileptic fits, and many authorities hold that this medication should be continued indefinitely.

It is our practice to get the patients up as soon as possible, usually about the fifth day, and to encourage them into as stimulating a régime as the circumstances allow in order to combat the post-operative lethargy

We have no doubt about the importance of active rehabilitation, to be started at the earliest possible moment Patients must neither be allowed to lie torpidly in bed for weeks nor discharged home to the care of relatives who cannot cope with them. They need supervision of their toilet at first and have to be pushed into activity. They may even require to be chivvied into occupying and interesting themselves. The duration of stay in hospital must necessarily depend upon a number of factors, not least of which are the degree of recovery from the pre-operative symptoms and the extent, if any, of the post-operative deterioration.

After the standard operation about 5 or 6 weeks of rehabilitation should suffice in a mentally recovered case.

COMPLICATIONS

The mortality is about 3 per cent, including all age-groups, but is usually smaller in young, healthy subjects. Death is most commonly due to bleeding. Delayed death has been reported, occurring six months or so after the operation and following upon a period of general decline; these have been correlated with too posterior an incision (Meyer and McLardy, 1948).

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(7) Finally, on the basis that the essence of the operation seems to lie in the destruction of thalamic nuclei, a direct attack upon the thalamus has been devised by Spiegel and Wycis (1949) who use a stereotaxic needle, with which it is possible to destroy selected areas by electro-coagulation. This is referred to as "thalamotomy".

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The alarming complications (such as hemiplegia) that followed some of the earlier operations are now very rare indeed. Rectal incontinence has never been other than transient in our cases, and urinary incontinence usually clears up in a few weeks or less, though there may be some residual tendency to frequency and precipitancy, which causes little inconvenience.

The incidence of epilepsy is still a matter of uncertainty. It used to be thought to happen in about 3 per cent of cases, but there is every reason to suppose that this figure should be more in the neighbourhood of 12 per cent. The fits, however, are rarely frequent and are usually easily controlled. If the patient has been free from fits for twelve months after operation there seems small likelihood of them occurring thereafter. We have not personally known epilepsy as a serious complication except in a few chronic male schizophrenics.

The operation may be followed by a pathological increase in appetite, but this is not persistent and seldom causes inconvenience. Gain in weight is usual and varies from a few pounds to a hundred pounds, while an increase of between 20 and 60 pounds is not uncommon. The majority of patients, however, return to near their normal weight within a year of the operation, although a very few, seemingly always women, continue to gain weight indefinitely.

GENERAL EFFECTS OF THE OPERATION

The general effects of the operation undoubtedly depend on its extent. The standard operation, in our experience, confers the greatest relief of symptoms but is liable to be attended by damage to the personality. More restricted operations may leave the personality intact but are often inadequate in relieving symptoms. In general, and taking the standard operation as our base line, the main effects may be considered under the following headings.

Relief of emotional tension.—The patients become more placid and their emotions

is that they worry less.

Reduction of inhibitions.—It may sound inconsistent with the above, but the patients are less restrained. In so far as they live for the moment, they are liable to say without reflection what comes into their minds and to gratify their whims with small regard for the consequences. The effect is that they may be outspoken, extravagant, greedy, inconsiderate and selfish. But it is important to emphasize that these undesirable characteristics are not necessarily more marked in the post-leucotomy patient than in the general public.

These post-operative changes, relief of emotional tension and relaxation of inhibitions, interplay with each other so that the resultant improvements vary according to the circumstances in which the patient finds himself, but in general the leucotomized person is less on his toes than he was before, and is therefore likely to be more indolent and less ambitious, with reduction of worry as part of the reduction of his general intensity.

—We have no doubt that there is always some post-operative

arkable how small this is and how little it

nistration of tests. The latter often offer less evidence of intellectual impairment than does observation of the patient in the life situation. The post-operative deficits seem to lie mainly in the finer shades of apprecia-

details.

Physiological changes.—It is the rule to find that appetite is increased, weight is

gained and sleep improved, whilst bowel action, if disordered before, tends to become more regular, as does menstruation. Urinary complications have already been mentioned.

FACTORS INFLUENCING RESULT

The total result depends upon a number of variables, amongst which are (1) the extent of the operation; (2) the previous personality of the patient; (3) the residual symptoms of the illness; and (4) the circumstances in which the patient finds himself.

After the standard operation the recovered patient living in sheltered circumstances may show no demonstrable abnormality at all. Even in unsheltered circumstances he may be capable of much. We have, for example, known a university professor, a bank manager, a clergyman and skilled executives to discharge their former functions no less satisfactorily after operation than before, and we have even known patients who *generally showed more initiative and enterprise post-operatively* than they did before they became ill. The idea, which seems prevalent, that the leucotomized patient is necessarily a robot is quite unjustified, though there is much to suggest that there is always a real reduction in the potential level of previous attainment. How much this is evident will depend upon the demands made on the patient. We cannot imagine, for example, a leading Chancery Silk returning to successful practice, but we have known doctors who post-operatively were able to practise, and practise as well as other doctors we have known, though that is not to say that they are as competent as they were before. In brief, the capacity to deal rapidly with complex situations is invariably impaired Since, however, the majority of the population are not called upon to do this, this type of deficit is often not apparent. In general, the better the previous personality and intelligence, the better are the results.

POST-OPERATIVE PROGRESS

The effect of the operation cannot be judged immediately. Not only is assessment of the recovery always difficult while the patient is still in hospital, but many patients continue to improve not merely over weeks but months. The final result cannot be assessed until at least six months after operation and even then further improvement is likely though there is also the danger of relapse. This last occurs most commonly in periodic psychoses such as recurrent schizophrenia and manic-depressive illness, especially where manic features have been prominent. Such relapses are usually milder than the original illness so that re-admission to hospital may not be necessary.

EFFECTS IN SPECIFIC CONDITIONS

It will be seen that this is a symptomatic treatment, the effect of which is to reduce emotional disturbance The beneficial results in different syndromes will depend largely upon the emotional state that is associated with them.

Schizophrenia

The operation has been more widely used for schizophrenia than for any other psychiatric syndrome because the condition is frequently associated with profound emotional disturbance as well as being the commonest and most *incapacitating* psychiatric illness.

The course of schizophrenia may be crudely likened to that of a switchback downhill The gradient of this switchback is, however, extremely difficult to predict, and the course of the illness in individual cases may be arrested spontaneously at almost any phase. There is, moreover, good reason to suppose that insulin shock treatment has the effect either of flattening the gradient or in certain cases of arresting the illness permanently. These points are important to bear in mind, for it is clearly undesirable

to run the risk of damage by operation in a case that might either remit spontaneously or be satisfactorily improved by insulin treatment. It is therefore fundamental that leucotomy should not be carried out before one can be satisfied that the patient is unlikely to show a spontaneous remission. Leucotomy in schizophrenia should also be preceded by insulin treatment if possible.

There is, however, evidence that the longer the illness the less is its response to leucotomy or to any other treatment. If the illness looks to be having a downhill course, without serious hope of remission, and there has been no response to insulin treatment, then there is no point in delay.

More than one-third of well selected schizophrenic cases (almost certain otherwise to be permanent hospital inmates) are likely to be enabled to leave hospital, though they may be far from cured; of the remainder, about one-third will be symptomatically improved so that they are able to lead less restricted lives and are easier nursing problems. Of the very few cases reported to be worse there seldom seems reason to suppose that the deterioration is due to the operation any more than to the inroads of the illness.

The simplex (or simple deteriorating) type, of insidious onset and characterized mainly by emotional flatness and apathy, does least well, as would be expected. The florid and turbulent types tend to do best. Good prognostic features are as follows.

(a) The sudden onset of illness in a previously good personality.
(b) Tendencies to improve, even though the improvement is not maintained, either spontaneously or with treatment.
(c) The occurrence of stupors in between bouts of excited behaviour.
(d) The absence of a "fixed pattern" in the illness, by which is meant that we like to see patients whose symptoms vary from one time to another.

Paraphrenic and other paranoid types of patients in whom the personality is relatively well preserved (by which is meant that it is possible to meet such a patient transiently and to think him normal) but whose delusions have become fixed, tend to show symptomatic improvement in that they are less emotionally disturbed. Although the delusions persist, they may be relegated so completely to the background that their elicitation may be a source of surprise even to relatives. The more fixed the

may post-operatively present to his relatives a difficult problem in management. This is usually because of erratic and unpredictable behaviour. We have even known relatives who have regretted the improvement for this reason, for whereas previously the problem was borne by the mental hospital it has then to be borne by themselves. Complaints about the post-operative personality occur most commonly among the schizophrenic group.

Affective disorders

We propose to include under this term a wide range of conditions and not merely that group known as "manic depressive psychoses". A misleading impression has arisen that all cases of depression respond to electrical treatment. Whilst many do there is quite a large group that does not, and it is for cases of this sort, chronically incapacitated and showing no tendency towards improvement, that leucotomy is reserved.

In general, the operation is most successful in those patients who show emotional excess rather than emotional poverty, that is in the agitated and the tense, rather than in the anergic. When recommending the operation, we are always glad to see a large reactive element in the illness and, correspondingly, are more guarded in the prognosis when the attacks appear to be essentially endogenous.

Involutional melancholia

It is convenient for our purpose to separate the involutional melancholias (depressive conditions occurring for the first time during the involutional period, accompanied by agitation and hypochondriacal ideas such as bowel blockage) from the manic depressive cases, and in our experience many of these melancholics either do not respond to electrical treatment or, if they do, quickly relapse. The state of misery of many such patients is profound. In our opinion leucotomy produces better relative results in this group than in any other This may be associated with the fact that many of them have had a good previous personality. Provided that the pattern of the illness has not become quite fixed and that it has not persisted without fluctuation for more than about two years, it is our experience that about two-thirds of these patients, or more, may be restored to near normality, whereas they would otherwise be hopeless, chronic invalids.

Manic depressive psychoses

The majority of manic depressive cases do not have manic phases, but when these do occur, with or without depressive ones, the prognosis for operative treatment should be the more guarded. There is a more obvious tendency for manic than depressive phases to recur post-operatively, although it is true that the severity of the manic attacks may be considerably reduced. There is also a possibility that manic phases may be precipitated by operation, and that post-operatively they may appear where they have never appeared before. Whatever the reason, those with a history of manic attacks are liable to show difficult post-operative personalities. Our opinion is that these factors, while calling for prognostic reserve, are seldom such as to justify withholding the possible post-operative benefit.

Undifferentiated tension states

Under this term we include a considerable variety of incapacitating conditions of functional origin, the disabilities being persistent, they are more easy to recognize than to describe Good results can be obtained amongst many of these cases, too, by removal of an affective load that they are unable to sustain. It is essential in this connexion to differentiate between those who have a load and those who think they have but have not For example, many hysterics complain incessantly of their burden, though observation shows that the fluctuating and purposive nature of their complaint can reasonably be regarded as an expression of their unsatisfactory personality rather than as an illness.

Obsessional states

These states as a class are peculiarly resistant to treatment and can be completely incapacitating For this reason leucotomy is especially valuable in obsessional conditions and some of the most striking results are obtained in this group. In our experience, those patients whose obsessions are apparent more in the form of rumination, phobias and compulsive thinking, do better than those in whom ritualistic behaviour (for example, hand-washing) is the main feature.

In general, obsessional tendencies remain post-operatively, but, except in some of the most severe cases, they are more easily kept within bounds, so that they disturb and incapacitate the patient to a much less degree. Obsessional components in the personality, which remain after operation, help to counteract undesirable post-operative disinhibition It is our experience that, provided the symptoms have not become so automatic and entrenched as to continue unchanged independently of the mood and the circumstances, almost all obsessional patients will show symptomatic improvement after operation. The more the disorder is confined to thinking (as in

rumination or compulsive thoughts) and the less that it involves behav hand-washing and other rituals) the greater is the likelihood of some "cure" being achieved.

In our opinion, there is a group of intractable and severe *hypochondri allied to the obsessional states*, namely those people with tension who are seeking medical advice to reassure themselves against their fears, for exam cancer. Such patients, provided that there is a real basis of tension arising tional over-concern, do extremely well with leucotomy in contrast to thos the hypochondriasis is more in the nature of a self-indulgent interest.

PHYSICAL INDICATIONS AND CONTRA-INDICATION

There are certain conditions arising from, or essentially related to, physical in which leucotomy has been found to be of benefit.

Chief amongst these are cases of intractable pain. In such cases the u operative effect is for the pain to remain but for the patient to be enabled t it more easily. This appears to come about as part of the reduction in th general intensity. Here again, it is essential to distinguish between thos whose complaints are expressions of their personality and those who are suffering. The less satisfactory the previous personality, the more is there be residual querulousness. In the optimal case the results can be asto regards cessation of complaint, ability to do without drugs, and increase in

Leucotomy has been suggested in a wide variety of so-called psychoso orders, for example in ulcerative colitis, and various skin conditions. Its us been invoked in spasmodic torticollis. We do not feel that anyone has experience for any certainty to be felt about the general results in such c although there have undoubtedly been individual successes.

The main physical contra-indications are arteriosclerosis and hypertensi to the increased risk of post-operativ [illegible] with cases of severe hypertension in [illegible] our practice in such cases to keep th [illegible] pre-operative period.

PSYCHIATRIC INDICATIONS AND CONTRA-INDICATION

A leucotomy should never be considered unless there is reason to suppose patient will remain severely incapacitated without it. Persistent social incapac *per se* an indication for leucotomy—the majority of criminals, alcoholics centred complaining hysterics are not helped by it and may be rendered e difficult in their behaviour after it. The essence of the decision lies in whether real load of symptoms as opposed to a façade of complaints. The correct jud [illegible]

not being able to continue a highly skilled job? Is the risk of releasing [illegible] sexual behaviour justifiable in trying to relieve resistant and suicidal depressi [illegible]

who must be tended hand and foot?

SUMMARY

In assessing the operative results, three questions may be put: (1) How does the

(1) Nearly all patients feel better from their own point of view. It is exceptional to meet patients who regret having had the operation, and this is not necessarily a reflection of their impaired judgment.

(2) As has been said, the results are that up to one-third of the chronic schizophrenics and more than two-thirds of the chronic depressives who would otherwise have been permanent inmates of mental hospitals have, post-operatively, been able to return home. Furthermore, of those patients who have been socially incapacitated although not in a mental hospital, a very large number are able to lead more able and productive lives. Very few patients are able to do less than they were doing before the operation (Partridge, 1950)

(3) The impression the patient makes on others can, however, constitute a real difficulty, although it is difficult to judge (especially in schizophrenics) how much these difficulties are dependent upon the residua of the illness rather than upon post-operative personality changes. It is wise to be more guarded in all cases with an unsatisfactory previous personality, for although feeling better and able to do more after operation they may be a trial to their friends and relatives.

We feel it important to stress here that the results should be judged against what the condition would have been without the operation, rather than against what the condition of the patient was before he became ill; and although we do not wish to underemphasize the fact that undesirable post-operative personality changes may occur, we believe it reasonable to stress that their extent and intensity has, in our opinion, been exaggerated. How much these effects are felt depends upon the sensitiveness of the friends and relations It is when these are imperceptive that the greatest post-operative satisfaction is found, but high degrees of satisfaction are also found even when the relatives are sensitive.

THE VALUE OF DIFFERENT TYPES OF OPERATION

On the evidence available to us the alternatives to leucotomy that have been mentioned seem to have no substantial advantage Not only does this appear to be the case clinically, but there are other technical difficulties. As regards gyrectomy or topectomy, for instance, we are informed by neurosurgical colleagues that the value of this procedure (which might seem at first sight to be more controlled and precise) is limited by the facts that (1) it is surgically more formidable, (2) it carries a greater [illegible]

(5) even if such areas are delimited there is such cyto-architectonic variation between one subject and another, that what may be area 10 (for example) in an anatomical sense is not necessarily area 10 so far as the cyto-architecture is concerned. The results of thalamotomy, likewise, do not appear to be clinically much different from those of leucotomy, while it demands specialized skill in the use of a rather complicated apparatus, the accuracy of which cannot be considered to be certain in view of the relatively wide anatomical differences that probably occur between one thalamus and another. Although temporal lobectomy seems to be effective in some cases of psychomotor [illegible]

at present the most reliable aids in the surgical treatment of psychiatric conditions.

In our experience, the standard operation is the one which exerts the maximal effect, although it may also be fraught with more undesirable consequences. When the symptoms are of extreme severity, it is unlikely that any less extensive operation will produce an effectual result. Its modifications, though preferable in maintaining

intactness of the personality, confer, in our opinion, less freedom from symptoms. They do not do as much harm, but they do not do as much good.

When dealing with a patient whose symptoms although severe are not overwhelming, and in whom there is some special indication for as much preservation of intellect and personality as possible, the less extensive operations have their place. We have had the opportunity of seeing the results in a number of non-insane individuals of (1) the standard operation; (2) McKissock's open rostral operation; and (3) McKissock's blind rostral operation, and our provisional conclusions are that, although the open rostral operation has been associated with benefit, a disconcerting number of these cases relapse and need a more extensive cut. We feel that McKissock's blind rostral operation is more satisfactory than the open operation, and it is so adequate in relatively mild cases that we would have hesitation in recommending the standard operation except in severe disorders, such as schizophrenia, severe involutional melancholia and paralysing obsessional states.

(*See also Surgical Progress, 1951*, pages 17 and 347)

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INTESTINES

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CONGENITAL ANOMALIES

Intestinal obstruction of the newborn

Browne (1951) has given in detail his management of babies suffering from some impediment to the normal passage of the intestinal contents. He stresses the importance of a nursing staff skilled in the post-operative management of babies and an anaesthetist competent in tracheal intubation He prefers during the operation to have the child struggle slightly so that its power of coughing and crying is recovered early. In operating on newborn children he describes what he calls a "double induction" technique for the maintenance of anaesthesia, the anaesthetic being discontinued throughout the whole period from the packing off of the abdominal contents to the closure of the peritoneum. He stresses the importance of having instruments, particularly needles, adapted to the size of the patient rather than to the size of the surgeon's hand. At operation he reconstitutes the intestinal canal about an atresia by what is virtually an end-to-side anastomosis of proximal blind end to distal loop, the incision in the proximal blind end being made transversely, that in the distal end longitudinally and of the same size. A single row of fine silk mattress sutures is employed.

Glover and Barry (1949) have reported 47 of their own cases of neonatal obstruction. They have shown again how much less serious obstruction of a newborn baby is when it is consequent upon a malrotation than on other forms of obstruction, and how much more serious an intrinsic atresia is than an extrinsic obstruction. The mortality rate in 24 intrinsic obstructions was 75 per cent, while of 16 extrinsic obstructions only 4 patients died. This rate is very similar to that reported by Ladd (1943) in his much larger series. The high mortality rate in the intrinsic obstructions he believes to be due to the completeness of the obstruction in these and the higher incidence of associated anomalies, chiefly cardiac. The accuracy with which diagnosis of the level of the lesion can be established is clearly shown by the straight x-ray plates reproduced in this paper. All authors underline the importance of post-operative gastro-enteric suction and adequate water and salt replacement in these children. The steady improvement in the mortality figures of babies suffering from intestinal obstruction soon after birth is known to be due to attention to these two factors Grove and Rasmussen (1950) have recorded 10 successive operations for congenital atresia of the small intestine with only 1 death; during the same period 5 babies were admitted suffering from this condition in too poor a state to permit of operation, and 4 of these indeed had associated abnormalities of a severe degree.

Meckel's diverticulum

The various ways whereby Meckel's diverticulum may attract the attention of the surgeon continue to be of interest to surgical authors, and several very complete reviews have recently appeared (Wagner, Shallow and Eager, 1950, Schwei and Jackson, 1949, Caylor, 1949; and Haber, 1947). One of the most complicated knots which a long Meckel's diverticulum can entwine around an adjacent loop of *intestine*, appearing incidentally to be initiated by a volvulus, has been described by Walsh

intactness of the personality, confer, in our opinion, less freedom from symptoms [illegible] ing, and in whom there is some special indication for as much preservation of intellect and personality as possible, the less extensive operations have their place. We have had the opportunity of seeing the results in a number of non-insane individuals of (1) the standard operation; (2) McKissock's open rostral operation; and (3) McKissock's blind rostral operation, and our provisional conclusions are that, although the open rostral operation has been associated with benefit, a disconcerting number of these cases relapse and need a more extensive cut. We feel that McKissock's blind rostral operation is more satisfactory than the open operation, and it is so adequate in relatively mild cases that we would have hesitation in recommending the standard operation except in severe disorders, such as schizophrenia, severe involutional melancholia and paralysing obsessional states.

(*See also Surgical Progress, 1951*, pages 17 and 347)

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EXTENSIVE RESECTION OF SMALL INTESTINE

The metabolism of the patient after massive resection of the small intestine has been the subject of a good deal of recent study. Mayer and Criep (1949) report the occurrence, the fourth of this kind in the literature, of tetany in a patient who had all but 4 feet of the small intestine excised, and a part of the remnant excluded, and advise close observation of the calcium level of patients who have undergone extensive intestinal excision. The patient made a good recovery on a diet of low fat, high protein, high carbohydrate and large doses of calcium with acidifying salts, vitamins B and D, together with tincture of opium and bismuth subcarbonate for the associated diarrhoea Shonyo and Jackson (1950) have successfully resected, for adenocarcinoma, all but 4½ inches of small intestine between the ligament of Treitz and the caecum. There was very little diarrhoea after operation, and the relief from this distressing complaint was attained, the authors believe, by maintaining fluid balance by parenteral routes and keeping the gastro-intestinal tract at rest for a very substantial time after operation. Though it is usually considered that a patient's intestinal tract becomes stabilized provided he survives the resection by a few months, Weckesser and his colleagues (1949) report 2 patients dying of inanition 9 months after resection of 88 per cent of the small intestine. They believe that distal resections of the small bowel are less well tolerated than resections of the proximal sections. One of the patients underwent his resection in stages for the treatment of regional ileitis. He lived normally for 4 years with 73 per cent of his small intestine resected but was unable to sustain life when an additional 15 per cent was removed One should be cautious in estimating the cause of diarrhoea after resection for Crohn's disease; often it is not easy after an extensive resection to decide whether diarrhoea is due to loss of small intestine or to recurrence of the disease at a fresh level. A very complete metabolic study is recorded (Berman and his colleagues, 1950) of a patient who survived resection of all but 18 inches of her small intestine, her rectum having been removed by abdominoperineal excision 9 years previously. Fat was well hydrolysed but its absorption was limited. Nitrogen equilibrium was maintained even though little more than half of the nitrogen intake was absorbed. The glucose tolerance curve was normal. The metabolism of patients after extensive resection has been studied also by Althausen and his colleagues (1949). These authors from their metabolic investigations deduce that there are 4 types of adaptation to massive resection of the small intestine adjustment in body-weight with consequent economy of protein usage, functional increase in absorptive capacity, anatomical expansion of the remaining absorptive surface and assumption by the colon of certain of the absorptive functions of the small intestine Authors who have studied the metabolic effects of massive resection of the intestine have been concerned only with the loss of the function of intestinal absorption There is another aspect of this post-operative situation which has received no attention. When an extensive amount of small intestine is excised, not only is an absorptive area lost, but a vast grazing-territory of the intestinal commensal bacteria is ablated. The importance of changes in the bacterial flora of the bowel in producing the diarrhoea, the emaciation and the haematological changes which may result from gastro-jejunal colic fistula suggest that the disturbances of nutrition consequent upon massive resections of the small intestine may be in some part due to the loss of the enteric flora.

REGIONAL ILEITIS

Armitage and Wilson (1950) have fully surveyed the literature on Crohn's disease and have traced a description of a characteristic lesion of the ileum described by Saunders in a contribution to the Royal College of Physicians in London in 1806 (Coombe and Saunders, 1813), which antedates a similar description by Abercrombie (1828). In a

(1950) in a male aged 63 years. A curious clinical anomaly in this case was the primary onset of pain in the back and not in the abdomen. This complication of a Meckel's diverticulum appears to have been much rarer in this present century than in the last.

Haemorrhage from a peptic ulcer in a Meckel's diverticulum continues to be reported fairly frequently, and Morton, Klyne and Zuckerberg (1950) in reporting the occurrence of this complication in an 18-month-old infant advocate a presumptive diagnosis of bleeding Meckel's diverticulum in any infants who have painless rectal haemorrhage of undetermined origin. Jay and his colleagues (1950) find that bleeding is the major symptom in 75 per cent of children who present with a Meckel's diverticulum under the age of 10 years. The youngest patient reported to have suffered from this complication was a female child of 11 months (Wilkinson, 1947).

Complete patency of the omphalo-mesenteric duct is less common perhaps than most other complications of this congenital abnormality. Over 100 cases of persistence of the duct have now been reported (Kittle, Jenkins and Dragstedt, 1947), and approximately one-quarter of them sustained a prolapse of the duct through the fistula. These babies present usually a granulomatous mass at the navel at birth with a small aperture at its centre though sometimes meconium drains into the remnant of the umbilical cord before that sloughs away and the condition may be mistaken for an infection of the cord. It is advised that such persistent fistulae, whose connexion with the bowel can be demonstrated by a little thin barium, should be excised as early as possible to avoid intestinal prolapse.

Tuberculosis of Meckel's diverticulum is exceedingly rare. MacDonald (1947) has collected 9 cases and added one of his own, which was secondary to a pulmonary lesion but which showed no signs of tuberculosis elsewhere in the intestinal tract.

Tumours arise with great rarity in Meckel's diverticulum, but Nygaard and Walters (1937) have recorded an original case of leiomyosarcoma in a man aged 62 years who had a coincident small duodenal ulcer The ulcer was radiologically demonstrable but the encapsulated tumour of the diverticulum was found only at operation. These authors were able to find reports of 2 previous cases of sarcomatous Meckel's diverticulum, and 2 other unpublished cases occur in the records of the Mayo Clinic.

Gas cysts of the intestine

Modern authors are not unanimous in subscribing to the view of Masson (1925) that the gas cysts sometimes found in the wall of the small intestine in patients suffering from duodenal ulcer or cancer of the stomach are due to interaction between chyle in the intestinal lymphatics and the acid products of intestinal fermentation. There is no question that these cysts seem to occur in patients on a milk diet (King, 1950; Jones, 1948) but others (Dale and Pearse, 1950) incline to the view first advanced by Biester, Eveleth and Yashamaru (1936) that malnutrition rather than dietary abnormality is the cause of the weakness in the intestinal wall. Biester, Eveleth and Yashamaru also differ from most others in that they admit the possibility of the intestine becoming in time obstructed by fibrosis in the walls of the cysts and they consider that resection is sometimes necessary.

Diverticulosis of the jejunum is usually regarded as a relatively innocuous anomaly, as it was shown commonly to be by Fraser (1933) and Edwards (1939) in their classical essays, but the occasional incidence of infection in a jejunal diverticulum (Fox, Johnson and Pfister, 1950), which may even proceed to perforation, should stimulate surgeons to keep the condition in mind in obscure cases of acute intra-abdominal inflammation or peritonitis. The cause of these diverticula still remains obscure but King (1950) has recorded regional ballooning of the adjacent intestine which he regards as aetiologically significant.

are commoner in men than in women. The radiological demonstration of carcinoids of the small intestine is rather difficult and a careful small intestine study is required for their detection. A correct pre-operative diagnosis was made by Miller and Herrmann (1942) who opined that the presence of dilatation of the small bowel, with a small filling-defect and kinking of the bowel at the site of the defect, was a characteristic picture. It has long been known that carcinoid of the small intestine is much more liable to behave in a malignant way than carcinoid of the appendix, metastases commonly developing in the regional lymph nodes though ultimately spreading in many cases to the liver and to other organs. Wrightson (1948) records widespread dissemination of the carcinoid of the small intestine to lymph glands, liver and heart muscle.

Primary carcinoma of the small intestine is even more predominantly a male disease than is carcinoid. The malignant epithelial tumours seem to have a greater predilec-

it is surprising that a tumour is palpable in nearly half of the reported cases (Pridgen, Mayo and Dockerty, 1950). Sometimes the haemorrhage in relation to these is quite substantial, and perforation occurs with some frequency (Somerville, 1951; Peterson, 1950). The disease spreads preferably by lymphatic routes but direct involvement of neighbouring loops of small intestine or such adjacent organs as colon, kidney and ureter, is not infrequent (Rabinovitch, Grayzel and Swyer, 1950). Occasionally carcinomas of the small intestine are multiple, as they may more commonly be in the colon, and Clark and Mills (1949) had one example of multiplicity with massive and repeated haemorrhage.

The connective-tissue tumours of the small intestine include a wide variety of rather rare conditions (Weinberger and Paltauf, 1948, and Eckel, 1948)

Lipoma of the small intestine: 67 cases have been reported from the Mayo Clinic, attracting attention in most cases by occasioning an intussusception (Smith and Mayo, 1950)

Neurofibroma (*neurinoma*) occasionally crops up (Moller, 1947).

Sarcomas of the intestine occasionally seem to have a nerve origin. Neural tumours may attain an appreciable size, some of them being palpable through the abdominal wall and a few detectable on rectal examination.

Leiomyomas of the small intestine seem to have a tendency to prolapse into the pelvis; Borrie (1949) reports of 1 case in which the tumour was situated in the terminal ileum

INTESTINAL OBSTRUCTION

The role of potassium

The important role of potassium in intestinal obstruction as in other studies of de-

Haist and Taylor (1940) that the elevation of serum potassium in intestinal obstruction is a terminal and not a causative event. The initial change is a loss of potassium. The serum potassium is only slightly decreased as a rule in clinical cases of intestinal obstruction but potassium loss is believed to occur not only from the serum but from the body cells and when sodium chloride is given intravenously the loss of potassium

and Clausen, 1951). The organism seems, however, to support even a very partial depletion of its potassium store much less successfully than it withstands loss of

careful study of 34 patients treated for regional ileitis in the General Infirmary at Leeds, Armitage and Wilson could find no relationship between the acute form of terminal ileitis and the chronic form with stricture and giant-cell systems. Like most other modern authors they advocate resection as the most suitable treatment where it can be safely performed. They prefer to use the term Crohn's disease in appreciation of the very complete clinical and pathological description of Crohn, Ginzburgh and Oppenheimer (1932) rather than any anatomical or pathological title, for so long at least as our understanding of the aetiology of the condition remains obscure.

The classification of the varieties of regional ileitis remains a little unsettled and it is sometimes difficult to be satisfied of the relationship of the various stages to each other. It certainly seems true that the very acute form of regional ileitis recovers and remains free from recurrence after resection more often than not (Homb, 1948). It therefore seems justifiable, and it is usually technically easy, to perform one-stage resection of a loop of small intestine the seat of acute phlegmonous inflammation. There is still no unanimity with respect to the treatment of the chronic varieties of regional ileitis manifest in cicatrizing stenosis, abscesses and fistulae, diarrhoea and the sprue-like state which makes life so miserable for these patients. More radical authors (Foss and Barnes, 1951) continue to advocate excision under all circumstances, but in the case of patients who have successive "skip areas" of enteritis, this may lead in time to resection of virtua[illegible] diarrhoea and malnutri- tion hardly less than woul[illegible] place for the short-circuit [illegible] *with multi-focal disease, or with abscesses or fistulae. The chief disadvantage of more* conservative intervention is a liability of the affected loop, even if excluded, to proceed to fistula formation. Such fistulae, developing in an operation wound, show certain peculiarities. Biopsy of that portion of the fistula which in one of my cases passed through the abdominal wall, showed in the wall of the fistulous track the same microscopic changes, with a diffuse cellular exudate and giant cell systems exactly similar to the pattern of Crohn's disease. The pathologist was able confidently to exclude tuberculosis Such an appearance is very suggestive of chronic bacterial infection and most writers hold the view that Crohn's disease is in fact a bacterial disease.

NEOPLASMS OF THE SMALL INTESTINE

Neoplasms of the small intestine are reported yearly in isolated cases.

Polyposis in its familial form is of course commoner in the colon than at other levels in the gastro-intestinal canal but the small intestine many suffer from this condition also, though usually with an absence of the genetic peculiarity and familial incidence of the colonic form of the disease. Sometimes the whole gastro-intestinal tract suffers from this condition, the stomach, duodenum, colon and rectum being involved (Welch and McHardy, 1949). When polypi occur in the small intestine they seem to be no less liable to malignant change and perhaps even more liable to haemorrhage than those in the colon and they may initiate a secondary form of intussusception.

The carcinoid or argentaffin tumour of all the other epithelial tumours of the small intestine is perhaps the most interesting. It is substantially less common in the small intestine than in the appendix, and occurs less rarely in the terminal ileum than in the upper reaches of the small intestine. It gives rise to intermittent episodes of small bowel obstruction associated with diarrhoea and loss of weight. Only rarely does it give rise to intestinal haemorrhage, for the mucosa is not as a rule penetrated early; indeed it is surprising that a submucous tumour can give rise to so much diarrhoea as enteric carcinoids sometimes seem to do (Grimes and Bell, 1949). The age incidence of the carcinoids of the small intestine is substantially higher than that of patients who suffer from carcinoid of the appendix, 57 years as compared with 30 years, and they

are commoner in men than in women. The radiological demonstration of carcinoids of the small intestine is rather difficult and a careful small intestine study is required for their detection. A correct pre-operative diagnosis was made by Miller and Herrmann (1942) who opined that the presence of dilatation of the small bowel, with a small filling-defect and kinking of the bowel at the site of the defect, was a characteristic picture. It has long been known that carcinoid of the small intestine is much more liable to behave in a malignant way than carcinoid of the appendix, metastases commonly developing in the regional lymph nodes though ultimately spreading in many cases to the liver and to other organs. Wrightson (1948) records widespread dissemination of the carcinoid of the small intestine to lymph glands, liver and heart muscle.

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INTESTINAL OBSTRUCTION

The role of potassium

The important role of potassium in intestinal obstruction as in other studies of demineralization is attracting increasing interest. It will be remembered [illegible]
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[illegible] and Clausen, 1951). The organism seems, however, to support even a very partial depletion of its potassium store much less successfully than it withstands loss of

sodium, and in patients with intestinal obstruction not only has a low blood potassium been demonstrated but even electrocardiographic changes characteristic of potassium lack have been recorded.

It should be remembered that the major part of the body's store of potassium is in the cells and the cells may be lacking in potassium when the serum potassium is normal, or even above normal if there is oliguria, as in fact there usually is in intestinal obstruction (Leading Article, 1951). The overt signs of potassium deficiency are not particularly dramatic but it may well be safe to assume that a potassium deficiency exists in all cases of dehydration and salt loss just as in intestinal obstruction. Certain surgical patients may suffer from potassium deficiency even if their state of hydration and their sodium chloride balance are within the limits of the normal. It may occur, for example, even without vomiting, after partial gastrectomy (Wilkinson and his colleagues, 1950; Snyder and Snyder, 1950; Smith, 1950; Marks, 1950; Evans, 1950). The clinical signs of the post-operative variety of potassium deficiency include apathy, weakness, abdominal distension or even ileus, disorientation, delirium and muscle twitching (Eliel, Pearson and Rawson, 1950; Darrow, 1950). Chemical estimation of serum potassium takes a little time to perform but the result may be obtained more quickly and more frequently where a flame photometer is available. As an alternative to direct measurement of potassium, the electrocardiogram has been used to indicate a serious lack. In patients with intestinal obstruction potassium lack is most pronounced after intravenous saline injection has been instituted but after operation for intestinal obstruction, or indeed for other intra-abdominal conditions, there is a further factor in decreasing potassium supplies in the maintenance of gastro-intestinal suction. Perhaps the best way of elevating the serum potassium safely after operation is the "early withdrawal of all tubes from all orifices", to permit the ingestion of well-cooked and sufficient food on as early a post-operative day as possible (Evans, 1950)

In general the therapeutic replacement of potassium in patients with potassium lack is slower than sodium replacement and it may take 4 or 5 days to return a patient to potassium balance Not only is the elevation of potassium a slower process than sodium replacement, it is in some circumstances more dangerous. Potassium intoxication may easily be produced by ill-advised parenteral injection of potassium chloride (Leonsins, 1951). Accumulation of potassium in the body is lethal when it reaches the level of about 40 milligrams per 100 millilitres. The symptoms and signs of hyper- [illegible] 1946) include mental confusion, thickness of [illegible] d heavi- [illegible] -dia and [illegible] high T wave, an absent P wave, with final total arrhythmia and cardiac arrest in diastole. This alarming syndrome might easily be produced by ill-advised parenteral potassium administration.

There is no danger provided the potassium is given by mouth, as it may be in doses of 6–18 grammes daily, and the urinary function is normal, but this route is not of course available for patients in intestinal obstruction. It is estimated that 0·26 gramme of potassium chloride per kilogram of body weight is safe if injected slowly intravenously over a period of 8 hours. It may be given in isotonic solution (11·4 grammes per litre) with 10 per cent dextrose provided the urinary output is at least 750 millilitres or more daily (Leonsins, 1951). Intravenous potassium administration should probably be made however only with repeated potassium determinations and with repeated electrocardiographic control.

Intestinal Intubation

The use of some form of intestinal intubation is now standard in the treatment of intestinal obstruction, and various modifications of the Miller-Abbott tube are

popular. The Cantor tube (Cantor, 1946 and 1950), which is a popular variety, and the Wild tube (Wild, 1949a and b), which in its most popular variety is loaded with mercury, are in fairly general use Cantor has analysed the physics of intestinal intubation and has shown the efficacy of numerous large holes in the suction tube as well as a larger bag of mercury than he designed initially. There still are difficulties, not always reflected in the literature, in passing any form of tube in an obstructed patient. I have even observed at operation on an obstructed patient the balloon at the tip of a decompression tube being passed backwards into the stomach by antiperistalsis in the duodenum. Wild advised distension of the stomach with air as soon as the tube had reached the fundus of the stomach, and the tube is then passed under fluoroscopic observation as far as the greater curvature. If there is delay at the pylorus the patient is placed prone for a few minutes and his head is depressed. Every effort is made to pass the tube as far as the jejunum before the patient is returned from the fluoroscopic table to the ward and the nurse is instructed to pass 4 inches of tube subsequently every hour, and periodic films of the abdomen are taken later. Cantor has observed the impediment which a short ligament of Treitz, angling the duodeno-jejunal junction, can produce to the passage of a decompression tube.

The direct complications of intubation are few but knotting in the stomach still occurs from time to time; necrosis of pharynx and even of laryngeal cartilages may occur if the intubated patient is in coma and lacks the swallowing reflex, and young dehydrated children submitted to prolonged intubation occasionally still seem to develop otitis media. There is on record only one case of perforation of the small intestine in the course of intubation (Berger and Achs, 1947). It is perhaps proper to mention again in this connexion the potassium depletion which may be produced or exaggerated by prolonged post-operative gastro-enteric suction

Morbid anatomy and physiology

The morbid anatomy and physiology of intestinal obstruction, apart from its electrocardiac effects, has been less studied since World War II than it was between the World Wars, but Harper and Lemmer (1946) have made a special study of the incidence of necrosis and ulceration of the intestinal wall even in simple intestinal obstruction. They found that the lower the obstruction, the greater was the incidence and degree of mucosal haemorrhage, necrosis and ulceration. They showed that the ulceration was due to the invasion, by normal intestinal bacteria, of tissue whose resistance had been lowered by the ischaemia of distension.

Bacterial infection

The importance of bacterial infection in strangulation of the bowel has been shown again by Laufman and his colleagues (1949). It will be remembered that the whole length of the small intestine of one animal, transplanted within the first day of life before organisms have gained entrance to it into the peritoneal cavity of another animal, is safely and insensibly autolysed (Aird, 1936) Laufman and his co-workers have proved that devascularized intestine of adult dog may similarly be transplanted without ill effect provided it is first rendered sterile. The importance of bacteria in producing the effects of strangulation, and indeed the changes in the mucosa which are present even above a simple obstruction, offer a very logical reason for the reduction in the mortality of intestinal obstruction which seems to have occurred since the routine use of penicillin and other antibiotics in these conditions (McLaughlin and Brush, 1950), and the protective action of penicillin (Laufman, 1950) and sulpha compounds (Poth and McClure, 1950) in preserving small intestine after vascular damage has been clearly proved by animal experiment. The toxic effect of too sudden decompression of grossly distended bowel has long been feared but Williams and

Williams (1950) advocate again the ancient practice of aspiration of distended intestine at operation by a suction tube inserted at the centre of a purse-string suture.

X-ray appearances

The roentgenological diagnosis of intestinal obstruction becomes more valuable as experience grows. The value of the scout film of the abdomen in cases of acute intestinal obstruction depends on the initial premise that normally gas is present in radiologically detectable amount in the stomach and colon but not in the small intestine. The exception to this rule is the case of the newborn infant, in whom gas may be seen in the small intestine without the presence of any obstruction. The method was first described by Schwarz (1911) and Case (1915). When an obstruction becomes established in the small intestine the coils of small intestine gradually become visibly outlined by gas and are disposed horizontally one above the other as in the conventional clinical ladder pattern of advanced obstructive disease. The valvulae conniventes are usually sufficiently clearly outlined to be recognizable. It is said that gas collects more slowly above a strangulation than it does above a simple intestinal occlusion (Wangensteen and Lynch, 1930); gas becomes demonstrably visible above a simple occlusion within a few hours of that occlusion being established. Lockwood (1941) and Hunt (1950) assumed that the visible demonstration in the x-ray film of valvulae conniventes signifies that the gas-filled loops are of dilated bowel above a simple occlusion, whereas in strangulation the valvulae are not distinct. It would appear logical to believe, however, that the presence or absence of visibly demonstrable valvulae conniventes depends only on the degree of distension; they disappear from grossly over-distended small intestine. Distended colon lies peripherally around the abdomen and shows no valvulae.

VARIETIES OF INTESTINAL OBSTRUCTION

Intestinal obstruction due to food

The kinds of foodstuff that may produce intestinal obstruction have been investigated in the literature and in clinical cases at the Radcliffe Infirmary, Oxford, by Ward-McQuaid (1950). It would seem that less than 0.5 per cent of all obstructions, including those due to hernia and peritonitis, are due to the impaction of a bolus of food. The commonest offenders are the resinous fruits of the persimmon group which are not true food boluses, for the obstruction which they produce is delayed long after ingestion. Peaches and oranges come next in the scale of obstruction-producing foods. Most of the offenders are foodstuffs rich in fibre, desiccated fruits which swell as they take up water, or substances resistant to the digestive juices. The bolus lodges usually in the lower ileum. It is rather remarkable that no fewer than four cases of bolus obstruction have followed a Polya type of partial gastrectomy and that two of these patients had suffered before the obstruction from dumping syndrome.

Gall-stone obstruction

The high mortality of gall-stone obstruction has again been stressed in recent papers (Denneen and Broderick, 1950). The fatality rate seems still to be of the order of 40 [illegible] was not made in any of the 9 cases [illegible] lthough in 3 of them a calcified mass [illegible] .one. None of the films showed, even on the very closest inspection, visible gas in the biliary tract. The operative treatment is of course removal of the stone, care being taken to dislodge it from the site of its impaction so that its removal can be undertaken through healthy bowel wall. These stones are always hard and no attempt should be made to crush them. Only exception-

ally can an impacted stone be manipulated into the colon (Kapel, 1947). A clear distinction is required between impacted gall-stones and bile-acid enteroliths which may develop in the intestine itself. It seems likely that they occur only if the choleic acid content of the bile is abnormally high, as it may be in hepatic or biliary disease. This matter has been fully discussed by Armitage, Fowweather and Johnson (1950) and it has a wide importance in relation to gall-stone ileus. It is sometimes a matter of wonder that in a case of gall-stone ileus the obstructing stone seems to be too large to have passed through the ampulla of Vater and the operator falls back on the explanation that it must have passed from gall-bladder to duodenum by a fistula which has subsequently healed. It is interesting to speculate whether, in such a case, the obstructing stone has perhaps formed in the lumen of the intestine itself. It is of note that the alkaline reaction necessary for stones to develop is found in the intestine only towards the lower end of the ileum and this no doubt explains why this should be a common level of obstruction when bile-acid enteroliths are responsible (Grettve, 1947).

Acute intestinal obstruction in typhoid fever

The longitudinal ulcers of enteric fever do not give rise to intestinal stricture as tuberculous ulcers used to do, yet occasionally intestinal obstruction may occur during or soon after an attack of typhoid fever. The obstruction is due not to an actual stricture of the bowel but to multiple adhesions developing at the site of patches of serous exudate on the peritoneal surface of the bowel at the sites of ulcer (Kane, 1948).

Paralytic (adynamic) ileus

The factors responsible for the development of post-operative paralytic ileus are still not fully understood and are subject to repeated investigation. There is no question that after any abdominal operation intestinal motility is reduced and in general one might say if this reduction in motility is prolonged the bowel may become so distended that recovery of peristalsis cannot be obtained spontaneously. Any tendency to mechanical obstruction, even by slender filmy adhesions, which would not normally prevent the propulsion of gaseous content may succeed in effecting an obstruction if it develops at a time when peristalsis is in this phase of post-operative inadequacy. The factors which lead to the post-operative loss of intestinal propulsion are still not understood There has been long argument about the effect of morphine, whose anomalous action in producing at once an exaggeration of peristalsis and a state of constipation has given rise to much dispute. It now seems clear that morphine, and other analgesics, such as pethidine and amidone, inhibit propulsion of intestinal content by producing a spasm of the musculature of the gut so that the fluid and gas content in any given loop is prevented from passing on to a loop more distal (Vaughan and Streeten, 1950). The importance of adequate electrolyte replacement in patients after surgical operation in preventing the onset of a paralytic ileus has been demonstrated by Streeten (1950) at Oxford, who has shown that the propulsive response of isolated intestine to Neostigmin and acetyl choline is notably impaired by reducing the sodium and chloride ions in the medium surrounding the strip of intestine under study

The very rapid gaseous distension which may occur in the intestine after operation has been subject to investigation by several workers. Begg (1948) suggested that the gas in the intestine was derived from the blood by "intestinal respiration", the gas passing directly from mucosal vessels into the lumen, but Maddock, Bell and Tremaine (1949) seem to have proved fairly conclusively that the air passes to the intestine from the external atmosphere by way of the oesophagus, not by repeated swallowing, which has previously been blamed, but rather by a relaxation of the superior oesophageal sphincter with aspiration of the atmospheric air during each respiration.

Two cases of paralytic ileus, both fatal, have been described in patients under trea[illegible] ment from hexamethonium (C6) (Hirson and Kelsall, 1951; Mackey and Shaw 1951).

Spastic ileus

Spastic ileus is much less common than the paralytic variety and is due to a greate[illegible] variety of causes. It is possible to list over 50 widely varied causes of this type o[illegible]

[illegible]

Grieve (1951) has recorded a curious intestinal obstruction in which the bowel immediately above a complete mechanical occlusion was found empty and collapsed at operation, and he believes that distension was in this case prevented from developing by an association of mechanical occlusion together with spastic contraction.

Mesenteric vascular occlusion

Mesenteric vascular occlusion remains perhaps the most lethal variety of intestinal obstruction and strangulation but the application of heparin to its treatment now offers to these very ill patients a little more hope. Rivers, Strug and Essrig (1948) have postulated from a review of the literature and from a long series of patients of their own, certain general statements concerning mesenteric vascular occlusion not all of which are equally widely appreciated.

(1) It is not true that the terminal branches within the bowel wall of the mesenteric arteries are "functional end-arteries"; these certainly have no communication between their larger branches but they anastomose freely in a diffuse submucous plexus.

(2) There is a considerable variation from individual to individual in the efficiency of the collateral circulation between these vessels: experimental ligation of a single terminal artery has little or no effect, yet cases have occurred in which focal necrosis and perforation have resulted in the bowel after embolic occlusion of single small arteries. It seems probable that spastic occlusion of patent collaterals may sometimes explain this variability.

(3) Obstruction of an artery proximal to the terminal arcade in the mesentery near its attachment to bowel leaves a sufficient collateral route by that arcade except in the case of very large vessels such as the main superior and inferior mesenteric trunks.

(4) Gradual occlusion even of these main trunks may, if it is slow enough, give rise to no symptoms at all and partial occlusion of these main vessels may give only minor [illegible] of function at the time when the partial occlusion occurs, though infarc- [illegible]

[illegible] obstruction has affected the arterial or the venous system, [illegible] systems are occasionally involved at the same time. While it is usual, however, for [illegible] to the venous [illegible]

of thrombosis [illegible] capillary bed was certainly present.

(6) The pathological changes in the bowel which follow mesenteric vascular occlusion depend upon the degree and suddenness of the occlusion and the effectiveness of the collateral circulation. In some cases there is no pathological change in the bowel. In others, a paralytic ileus may occur without any more demonstrable change in the bowel than congestion. In still greater degrees of occlusion there may occur ulceration of the mucosa (when blood usually extravasates into the lumen) haemorrhage into

the bowel wall, focal or massive infarction (with extravasation of blood both into bowel and into peritoneal cavity and mesentery) and, lastly, perforation.

(7) Usually there is no gaseous distension of the involved segment of bowel, yet generally there is sufficient gas present in the affected segment to be radiologically demonstrable.

Of the clinical features, pain is invariable in all patients sufficiently conscious to record it There is first a prodromal variety of diffuse intermittent abdominal pain, often colicky, and lasting for days or even several weeks (Berry and Bougas, 1950), and there may be a past history of episodes of migrating thrombophlebitis, pulmonary infarction or thrombophlebitis of the lower extremities. The pain at the time of onset of the major infarction is colicky at first but later becomes constant and increasing in severity, located rather vaguely in the middle or lower abdomen. Tenderness is less dramatic until peritonitis develops and rigidity is often surprisingly slight. Distension is less obvious than in perhaps any other form of intestinal obstruction The patient falls into a low blood pressure state which cannot be corrected by the intravenous administration even of blood Nausea and vomiting are not severe and haematemesis is rather unusual, occurring in marked degree only in mesenteric thrombosis due to portal hypertension; the haematemesis in these seems to be due often to concomitant oesophageal varices rather than to the vomiting of blood from infarcted bowel. Melaena is very much less frequent than one would expect from the large amount of blood which the bowel so often contains. Peristalsis is probably exaggerated in the early stages of the attack but almost invariably, by the time the patient reaches hospital, peristalsis cannot be heard. The temperature is usually elevated in slight degree and there is a very high leucocytosis. Since the intestine is not much distended by gas an abdominal swelling is not often palpable, but in late stages of the disease there may be a doughy mass at the site of the infarcted bowel

The causes of mesenteric vascular occlusion are the causes of vascular occlusion in general. Arterial embolism seems to be the commonest cause of those infarctions whose cause is known, the emboli originating in heart, aorta or aneurysm. Arterial thrombosis may occur in thrombo-angiitis obliterans (Garvin, 1947), mesenteric arteriosclerosis or mesenteric sclerosis. Venous thrombosis has been described in portal hypertension and a combined arterial and venous thrombosis seems sometimes to happen in Buerger's disease. Rivers, Strug and Essrig (1948) cite an instance of venous thrombosis in a patient suffering from disseminated lupus erythematosus and a case in which the thrombosis seemed to be secondary to the intestinal lipodystrophy of Whipple When all of the known causes of thrombosis can be excluded there still remains a substantial number of cases in which no disease can be demonstrated either in the intestine or the mesentery or the mesenteric vessels. This type of infarction Berry and Bougas call "agnogenic" mesenteric thrombosis. It is not known whether [illegible] nesentery, or to a distant [illegible] increased coagulability, [illegible]

The use of anticoagulants seems to have lessened the mortality of this disease but in many cases now the diagnosis of mesenteric vascular occlusion is made on very slender grounds and, if heparin is given without surgical operation, the diagnosis is rarely confirmed and must remain a little speculative. Most surgeons advise a combination of laparotomy and heparinization so that there will be no risk of overlooking bowel which has already become the seat of irreversible necrosis.

The literary history of mesenteric vascular occlusion dates back to the clinical work of Tiedemann (1843) but Berry and Bougas refer to a description by Antonio Beniviene (quoted by Allbutt in 1905) in Florence in the latter part of the 15th century and Hodgson, of Guy's Hospital, recorded a case in 1815.

The great post-operative danger for the patient after resection of an infarcted loop

of intestine is the spread of thrombosis from the area of operation to previously unaffected bowel. Nelson and Kremen (1950) have shown experimentally that the period over which a temporary clamp may be applied to a mesenteric vessel may be very substantially lengthened, the bowel recovering its vitality completely if heparin is given. They conclude that when the superior mesenteric vein is occluded by clot, the retarded flow in collateral channels produces "sludging" of the corpuscles in potentially anastomotic vessels. This "sludging" leads in due course to thrombosis and the potentially anastomotic channels cannot operate effectively; if heparin is given, either the "sludging" is prevented or else the sludged corpuscles are prevented from adhering to the walls of the vessels in which they lie.

Inferior mesenteric arterial occlusion

Occlusion of the inferior mesenteric artery or vein is relatively rare. Most authors do not even refer to it in connexion with intestinal vascular occlusion. Russell (1950) records a case of inferior mesenteric vascular occlusion due to arteriosclerosis; the bowel in this case presented at operation an anaemic infarct, an extremely rare phenomenon in the history of intestinal vascular occlusion.

Intestinal volvulus

Acute volvulus of the small intestine is perhaps second only to mesenteric vascular occlusion as a fatal form of intestinal obstruction. The commonest type of volvulus of the small intestine is that which occurs in newborn children and which gives rise to the signs of duodenal obstructions, yet Moretz and Morton (1950) have reported an analysis of 36 cases of which only 5 were under 20 years of age and 11 were over 60. Even in this predominantly adult group there was virtually always some other abdominal abnormality present, taking the form either of fixation of a part of the bowel by adhesion or some abnormal form of intestinal rotation. In the infantile variety it is rather uncommon for the twisted intestine to proceed to actual infarction, yet of these adults nearly half had irreversible circulatory change, with gangrene in one patient and in another there was a gross perforation of the bowel. The mortality of volvulus rose very steeply with age in this series. In patients under 60 years of age the fatality rate was 16 per cent, while in patients over 60 years of age it was 73 per cent.

Volvulus of the caecum

Donhauser and Atwell (1949) have surveyed volvulus of the caecum in great detail. There have now been approximately 400 cases recorded at the rate of approximately 4 per annum. The developmental fault which predisposes to this form of volvulus is of course inadequate fixation of the caecum, but pregnancy, previous operations, a high roughage diet, strong catharsis and unusual exercise are all said sometimes to precipitate volvulus. The condition is commonest between 25 and 50 years and a high proportion of the patients give a history of repeated attacks. In 25 per cent of the patients the caecum proceeds to gangrene before operation is performed. The x-ray appearances are helpful in arriving at a diagnosis. Radiography shows the pattern of small bowel obstruction with a large gas-distended loop on the right side, persisting after a small enema. In subacute cases barium enema may be shown to fail to pass the hepatic flexure. Moore (1949) has recorded a volvulus of the caecum lying within the sac of a right inguinal hernia and presenting as a strangulated hernia. Five instances of this curious type of volvulus of the caecum have been previously recorded.

When volvulus occurs as a complication of labour it is usually the pelvic colon that suffers but Murray (1950) has recorded a volvulus of the transverse colon occurring during labour in a pre-eclamptic mother.

Acute intussusception

Acute intussusception has received a considerable amount of attention during the last two years. A monograph from the University Clinic of Lund (Hellmer, 1948) is an important contribution to many aspects of the subject. Hellmer is not satisfied that the classic statement, "An intussusception grows at the expense of distal bowel, its apex remaining constant", is true. He believes that initially the intussusception takes the form of a kind of peristalsis, the apex changing as the intussusception grows, but that subsequently, but only for a time, the clinical dictum is true, the intussusceptum passing on into the sheath directly until it gets held up by its mesentery. When finally the mesentery prevents further growth of the intussusception, a secondary descent occurs, the apex of the intussusception passing onwards into the distal colon without the length of the intussusception increasing greatly, the sheath being thrown into telescope-like folds over the inner layers as the apex proceeds. It is usually stated that the commonest age of onset of an infant intussusception is 6 or 7 months but today in England, though the condition is rare before 6 weeks, one-third of the cases occur between the third and sixth month (Morrison and Court, 1948) and male predominance is less common than it used to be, at least in the North of England. A close connexion with the actual time of weaning cannot be substantiated. Morrison and Court, whose paper is an important one, further show that the passage of blood after the onset of an intussusception is by no means common; it was quite absent in 24 cases in their series of 100 and in only 56 cases was blood passed during the first 24 hours. Contrary to classical belief, nearly all infants with intussusception had some degree of pyrexia and half of them had a temperature over 100° F. A small number of children, with no evidence of systemic infection, had a hyperpyrexia of 104° F. together with frank convulsions. The same authors advised against waiting for a palpable tumour before proceeding to treatment, in about one-eighth of all cases no tumour was palpable

The question of prime surgical importance today is whether to treat infantile intussusception by hydrostatic reduction or by immediate operation. The method of hydrostatic reduction was first introduced by Hirschsprung in 1876 though perhaps Hippocrates had it in mind when he advised the forced injection of water or air into the rectum as the treatment of all forms of intestinal obstruction. Renewed interest in this form of treatment was stimulated by Hipsley (1926) in Australia, and the method has gained popularity in Baltimore (Ravitch and McCune, 1948). Ravitch has many arguments for hydrostatic reduction. He believes his more conservative method gives a lower mortality, and certainly his fatality rate of 10 per cent over all cases is relatively low, but it must be remembered that he and other authors holding the same views compare that mortality rate with an operative mortality rate over a period before the last war, when general post-operative mortality was substantially higher. He claims more than this, however, in that the hydrostatic method gives a lessened morbidity and the hospital stay of the children treated by enema is only 9 days as opposed to 32 days for those treated by operation. Rather than saline solution, Ravitch advises an opaque enema technique. As soon as the presumptive diagnosis is made the child is taken to the fluoroscopic room and the operating room is prepared (or warned) An unlubricated folding bag catheter is inserted in the rectum and distended with 20–40 cubic centimetres of air, according to the size of the patient. The catheter is not lubricated so that there will be less tendency for it to slip out, and an assistant squeezes the buttocks together Barium is permitted to run in from a pressure head of 3 feet and it runs rapidly until it reaches the apex of the intussusception, where it produces a concave meniscus The ends of the meniscus extend proximally as narrow lines of barium until the intussusceptum gives ground, though a bubble of air preceding the barium column may alter the fluoroscopic picture Complete reduction is shown by a visible flow of barium beyond the caecum into the small intestine. This is sometimes a little

difficult to appreciate but it helps if the caecum is displaced laterally by the hand. If complete reduction is not achieved the child is allowed to expel the enema, which is repeated. If the third enema fails, operation is performed.

If reduction is satisfactory the child is returned to the ward, powdered charcoal is passed by tube into the stomach and an attempt made to recover it 6 hours later by enema. There are five criteria of successful reduction: (1) barium passes well into the small bowel; (2) barium is returned with faeces or flatus; (3) a mass is no longer to be felt in the abdomen; (4) the child has obvious relief from pain; (5) charcoal is returned or a blood-free stool is passed.

Ravitch enumerates the objections sometimes raised to the hydrostatic method. (1) uncertainty of original diagnosis; (2) uncertainty that reduction has been complete; (3) higher recurrence rate; (4) failure to detect a secondary intussusception due to polyps; (5) delay of final reduction in unsuccessful cases; (6) rupture of the bowel; (7) reduction of non-viable bowel.

He answers these objections thus:

(1) Barium reduction ensures greater accuracy of the original diagnosis of intussusception.

(2) A false assumption of complete reduction was made only once in 27 children.

(3) Ravitch has found the recurrence rate to be about 2 per cent whether reduction was effected by hydrostatic means or by surgery. This is a rather interesting question. Hellmer finds the recurrence rate after barium reduction to be much higher than after operation, in the neighbourhood of 10 per cent, but he employs hydrostatic reduction without an anaesthetic and believes that his patients continue after his reduction to have that increase of peristalsis which led initially to the original intussusception. Perhaps the reason for the low incidence of recurrence in the Ravitch series is that Ravitch employs general anaesthesia for his hydrostatic reduction and so damps down intestinal peristalsis during the succeeding few days.

(4) Ravitch considers the risk of missing a causative tumour to be unimportant in young children; tumour is responsible in intussusception in only 2·5 per cent of children under 2 years of age and in any case the tumours that cause intussusception are rarely very serious in themselves.

(5) He does not regard delay as a very serious risk, for his whole procedure seldom takes more than half an hour.

(6) Ravitch does not consider it possible either to reduce a gangrenous intussusception or to rupture the bowel by a pressure head of 3 feet of barium, and he recalls the advice of Forest (1889) who advised that when reducing intussusception by enema one should "lay the child in the hallway and mount the stairs holding the fluid reservoir, but exercising caution after mounting to a height of 10 feet". Nelson (1949), using Hipsley's saline enema method, and Lindberg and Morales (1949), using the Swedish barium technique, also quote figures in favour of a hydrostatic method.

It cannot be said, however, that hydrostatic methods have yet commonly replaced surgery. Gross and Ware (1948) report a mortality of 2·7 per cent in cases treated by operation and this decline has been most notable from 1940 to 1947. The post-operative fatality rate has fallen in the Children's Hospital at Boston from 60 per cent in 1912 to 12 per cent in 1933 and 2·7 per cent in the years 1946–47. This remarkable reduction in mortality latterly has occurred during the period when advocates of hydrostatic methods have shown their greatest success.

Gross and Ware record 11 recoveries in 14 resections of irreducible or gangrenous intussusceptions by the use of a closed aseptic exteriorization method. Healthy bowel above the intussusception is sewn to healthy colon below the apex by a series of intermuscular stitches and the wound is closed around the neck of the intussusceptum. Clamps are applied at both ends of the extruded loop and the intussusception is excised, leaving two open bowel ends each controlled by a crush clamp. A tube is then

passed by a stab incision through the proximal bowel close up to its controlling clamp to act as an enterostomy. Several days later the clamps are removed to leave a double enterostomy which is closed subsequently by an extraperitoneal procedure. The improvement in the results of resection for irreducible or gangrenous intussusceptions is having a most beneficial effect upon the morale of surgeons. While the mortality rate [illegible] the [illegible] ably hopeful as a method of treatment, the surgeon is more inclined to proceed to it at a stage when the child has not been intoxicated by the squeezing of infected material into his circulation. The effect of this optimism on the figures of resection of intussusception (13 survivals from 17 resections) has been recorded elsewhere (Aird, 1949b). Snyder, Kraus and Chaffin (1949) also advocate surgery and record a mortality of 4 per cent in 125 consecutive cases Where their patients had a previous history of diarrhoea before the onset of symptoms, or where at operation the intussusceptum after reduction remains the seat of obvious vascular inadequacy, streptomycin 1 gramme, in 3 millilitres of saline solution, is injected by a fine-gauge needle into the bowel proximal to the intussusception as a supplement to the parenteral administration of antibiotics which they always employ after operation.

Intussusception in adults

Intussusception in adult persons is not very common. In its commonest form it probably occurs in the colon as a complication either of benign submucous tumour or of carcinoma The intussusception is in these cases relatively easily reducible, sometimes being recurrent. Most clinicians are familiar with the carcinoma of the colon which presents on physical examination a tumour that varies from day to day in size by reason of the secondary intussusception which it evokes Donhauser and Kelly (1950) have classified the primary cause of adult intussusceptions in 665 cases culled from the literature. Nearly one-third of these were ileo-caecal. Benign tumours were [illegible] per cent of tumours of the small intestine led to intussusception and put on record the occurrence of intussusception in two members of a family affected by inherited adenomatosis of the small intestine. Theirs is only the fifth case in the literature of familial intussusception due to familial tumours. One famous family recorded successively by Sharber (1910), Road (1932), Haggard and Floyd (1935) and Miller (1939) provided a total of nine resections for intussusception due to adenomas of the small intestine

(*See also British Surgical Practice*, Vol 5, page 148, S Keys 195–199.)

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VASCULAR SURGERY—CHRONIC OEDEMA OF THE LEG

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Disorders of [illegible] of chronic oe[illegible] either case th[illegible] often leads t[illegible] attacks of cellulitis and fever are prominent when lymph drainage is poor.

BASIC PHYSIOLOGY

Little advance in treatment or understanding of these disorders is possible without knowledge of the normal exchanges which take place between blood and tissues. Modern ideas are built on the explanation put forward by Starling in 1895. This, in principle, states that the outward movement of fluid from the capillaries depends upon the hydrostatic pressure of the blood and that reabsorption of fluid from the tissues is effected by the osmotic attraction of the plasma. In these exchanges the capillary endothelium acts as a semi-permeable membrane in which there is no secretory activity like that postulated in the older theories.

Landis, whose experimental work has contributed so much to our knowledge, reviewing in 1934 the vast amount of data which had accumulated on the subject, stated that no serious objection to the main features of Starling's hypothesis had arisen. Drinker and Yoffey in 1941 came to the same conclusion. Table I, which is based on some of Landis's experimental data, shows in outline the main features of tissue fluid exchange which are accepted today.

TABLE I

Capillary		*Tissue fluids*	*Lymph*
Arterial end Blood pressure 30 mm. Hg + Colloid osmotic pressure 25 mm. −	+ 5 mm. →	Water + small percentage of protein	
		Tissue fluid →	Water + small percentage of protein
Venous end Blood pressure 10 mm. + Colloid osmotic pressure 25 mm. −	− 15 mm. ←	Water	

Some of the factors which may alter this balance will now be considered.

Hydrostatic changes

Increased pressure in the arterial end of the capillary leads to more filtration of fluid into the tissues. Waterfield (1931) has shown that the feet of normal men swell during quiet standing. The pressure in the capillaries is, however, lessened by constriction of arterioles. It is possible that sympathectomy which is sometimes advocated for "gravitational ulcers" may, by interfering with this arteriolar constriction, increase the tendency to oedema formation.

Changes in pressure in the venous end of the capillary are even more important in relation to oedema than those at the arterial end. Landis (1934) and others have shown that venous congestion raises capillary pressure often above the osmotic pressure of the plasma. Unless the pressure drops below the colloidal osmotic pressure of the plasma, reabsorption of fluid is impossible.

In the normal erect man venous and therefore capillary pressure tends to be reduced by the action of muscles on the valved veins. Should the efficiency of these valves be reduced by disease there is a tendency to oedema formation in dependent limbs. This factor will be considered in greater detail later.

Tissue tension

Filtration from the capillary is countered by the pressure of fluid in the surrounding tissues. This is normally very low but rises as oedema occurs so that it may finally stop filtration altogether. This rise in tissue tension may be made steeper by applying supporting bandages so that filtration and, therefore, oedema formation is halted sooner The high tissue pressures which are known to exist in contracting muscles probably account for the common finding that the leg muscles do not become oedematous in post-thrombotic limbs even though skin changes are advanced.

It has been suggested that oedema might be due to reduced elasticity of the tissues, but the experimental work of Bönninger (1905) showed that this is not so.

Capillary permeability

The normal capillary endothelium is freely permeable to electrolytes and water but almost completely impermeable to protein. Its microscopic structure suggests that it acts only as a passive membrane for physical filtration and that it is incapable of active secretion. Changes in its permeability are sometimes invoked to explain oedema formation, but, according to Landis (1934), analyses of oedema fluid, blood and lymph show that the capillary wall is relatively impermeable and retains at least 95 per cent of the total plasma protein. The evidence for supposed alterations in permeability is usually invalidated by lack of control of all the possible physical factors involved in filtration.

The permeability of the capillaries is altered, however, if they are damaged by such agents as heat, chemicals or bacterial infection, in other words during acute inflammation.

Colloid osmotic pressure of plasma

This is due to the proteins of plasma and is the chief factor responsible for reabsorption of tissue fluid. [illegible] pressure of the plasma.

When the plasma proteins fall below normal levels, as may happen in starvation, renal disease and other conditions, a failure of reabsorption of tissue fluid occurs with consequent oedema. It follows that during the investigation of any patient with oedema of uncertain origin, plasma protein levels must be measured.

Composition of tissue fluid

In the normal subject there is probably little difference in electrolyte content between plasma and tissue fluid but, owing to the impermeability of the capillary wall, there is a great difference in the protein content. Landis (1934) points out that direct measurements of tissue fluid composition under normal conditions have never been made. Our knowledge has been obtained indirectly by study of lymph and of oedema fluids. The estimations made by Landis (1934) and other workers, of protein in oedema fluids due to varying causes, all show that the level is low. The levels in oedema due to cardiac failure, renal disease, malnutrition and artificial venous congestion ranged from 0·09 per cent to 0·4 per cent. This confirms that some 95 per cent of plasma protein is retained by the capillary wall which retains its permeability unaltered in these conditions.

In oedema due to lymphatic obstruction, however, the protein content of tissue fluid rises. Drinker, Field and Homans (1934) found the level to reach 3·3 per cent in a patient with lymphoedema, and 5 per cent in dogs with artificially blocked lymphatics.

Ratcliffe (1950) investigated the protein content of "extravascular fluid" in the legs of patients who suffered from the after-effects of deep venous thrombosis and found that it was usually about 0·5 per cent and only rarely above 1 per cent. The first figure is only slightly higher than those quoted from Landis and does not support the suggestion which is sometimes made that lymphatic obstruction is an important element in these cases.

Lymphatic obstruction

There is now much evidence that protein is absorbed from the tissue spaces by the lymphatics alone (Landis, 1934; Drinker and Yoffey, 1941). The work of Field and Drinker (1931) showed that serum injected subcutaneously passed rapidly into the lymphatics but that no absorption could be detected through the capillary wall during an hour. It is therefore to be expected that lymphatic obstruction will cause a rise in the level of protein in tissue fluid, and this does in fact occur in clinical and experimental conditions.

Lymphatic stasis is of less serious consequence than capillary stasis. In the first case water and protein pass into the tissues but are not absorbed again, water because the effective osmotic pressure of the blood is counteracted by the rising protein content in the tissues, and protein because the lymphatic route, which is its sole exit, is blocked. The exchange of gases and electrolytes, however, need not be hindered; Landis (1934) says: "The exchange of diffusible solutes to which the capillary wall is more or less permeable need not follow the current of water during either filtration or absorption."

During capillary stasis, on the other hand, all exchange stops. There is even a migration of red cells into the tissues from the capillaries during venous congestion, as Cohnheim showed in his well-known experiments in 1867. The nutrition of the tissues is far more seriously threatened, and this explains why the skin of lymph-oedematous legs may remain in good condition for years despite gross oedema while that of patients with venous disease is subject to pigmentation, dermatitis, ulceration and other changes.

THE NATURAL HISTORY OF VENOUS DISEASE IN THE LEG

Chronic ulceration of the legs is such a common condition that Dickson Wright has at different times calculated that the total area of ulcerated surfaces treated in his clinic has been equal to that of several tennis courts and that the economic loss caused has amounted to millions of pounds. Confusion about the causes of these

ulcers has led to a host of different names for them; hypostatic, gravitational, varicose, post-thrombotic and post-phlebitic are examples. It has been known since the nineteenth century from the work of Gay (1868) and others that uncomplicated superficial varices were by no means the only cause, for post-mortem examination often revealed evidence of deep venous thrombosis.

Anning (1949) has made a clinical study of the causes of these ulcers and found that in only 11 per cent of his patients were they due to primary varicose veins. In the remaining 89 per cent deep thrombosis was diagnosed as the cause because at some time in the past there had been sudden swelling and pain or muscular tenderness in the limb. Most often this had occurred before or after childbirth or followed local injury or infection.

Birger in 1947 estimated that 40 per cent of a group of patients with ulcerated legs had previously suffered from deep thrombosis. His criteria of diagnosis were very strict and he thought that the true percentage might be even higher.

Most workers, although they would agree that the incidence is high, do not find a history of deep thrombosis in as many cases as Anning, even when the patients are closely questioned. Anning's patients were treated in a dermatological department so that the figures might perhaps be different from those in surgical practice. In the latter the proportion of ulcers due to primary varices would be higher as they respond better to surgery and are therefore not referred to other departments.

The effect of hereditary factors in ulceration of the legs was studied by Anning (1950) in 525 patients. Patients with ulcers after fractures, infection and similar causes were considered as a group uninfluenced by heredity. One-quarter of these gave a family history of varices or leg ulcers and this figure was taken as the incidence of hereditary factors which would occur by chance alone. Other groups in which a significantly higher proportion gave a positive family history are shown in Table II.

TABLE II

Ulceration due to	*Percentage with positive family history*
Primary varices	90
Post-partum thrombosis	53
Ante-partum thrombosis	61
Idiopathic thrombosis	63
Thrombosis after operation on leg	63
Thrombosis after operations elsewhere than leg	50

Anning emphasizes that these patients usually did not have varices themselves before thrombosis occurred but gave a family history of varices, thrombosis or ulcus cruris. He recommends that these patients should have special measures taken to prevent thrombosis if they are to undergo operation or childbirth, or if they have fractures.

PRESSURE CHANGES IN THE VEINS OF THE LEGS

Smirk in 1936 made the first direct measurements of the pressure changes in the veins of the foot on walking. Many further studies have since been made and it is clear [illegible]

the patient walks because of the pumping effect of the leg muscles on the veins and their valves.

Pollack and his colleagues (1949) at the Mayo Clinic, using a fine catheter con-
nected to a [illegible]

[illegible] on walking, a figure lower than the normal colloid osmotic pressure of the blood which is 25–30 millimetres. Theoretically, therefore, it is possible for capillary reabsorption to occur in normal people during walking.

Patients with incompetent superficial varices had pressures of 7 millimetres when lying, 52 millimetres sitting, 82 millimetres standing and 45 millimetres when walking.

In patients with superficial venous incompetence and a history of ileo-femoral thrombophlebitis the figures were 10 millimetres lying, 88 millimetres standing and 77 millimetres when walking. The time taken for the pressure to rise again after walking varied in the three groups. It was 31 seconds in the normals, 3 seconds in the patients with primary varices and one second in the post-thrombotic subjects.

Walker and Longland (1950) have studied the changes in pressure in the surface veins of the foot in exercise in normal and diseased limbs. They introduced a fine polythene tube filled with saline solution into the vein and connected it to a mercury manometer. They confirmed the reports of other workers that the venous pressure in the foot at rest was equal to that exerted by a column of blood as high as the patient's heart above his foot, usually about 90 millimetres of mercury. This pressure fell in normal people to about 20 or 30 millimetres on walking or "marking time". In patients with varicose veins the pressure often remained high on exercise but dropped if a tourniquet was first applied lightly below the knee. Some of these patients had the test repeated after ligation of the great saphenous vein: the pressure decrease on exercise was better but not as good as it had been with the tourniquet. It is interesting that White and Warren (1949) in similar studies found that stripping operations for varicose veins produced a greater improvement in function than ligation alone.

Walker and Longland (1950) found that patients with thrombosis or incompetent femoral veins had little or no fall in venous pressure on exercise. In recent years patients suffering from the after-effects of thrombosis in the deep veins of the leg or thigh have been treated by ligation of these veins in the hope that function might be improved by blocking incompetent channels in the same way that ligation of incompetent superficial veins helps patients with primary varices. Buxton and his colleagues in 1944 reported the early clinical results of tying the femoral vein which had been first suggested by Homans in 1941. Bauer reported the results of popliteal vein ligation in 1948. These clinical results will be discussed later. Walker and Longland (1950) measured the venous pressure of such patients before and after operation. Three of their patients had ligation of patent but incompetent superficial femoral veins but there was no improvement in their disease and the tests showed no change in the pressures on exercise. Seven patients had their popliteal veins tied and four of them showed clinical and manometric improvement: they had had the best pressure responses on exercise before operation. Three patients responded poorly. They had already had sympathectomies and in two cases superficial femoral vein ligations as well. Walker and Longland suggest that sympathectomy might decrease valvular competence by dilating the veins as well as by bringing more blood into a limb which already has difficulty in emptying itself.

Walker (1950) reviewed the results of popliteal vein ligation in a larger number of cases than he had reported with Longland. He confirmed that patients whose preoperative tests showed no fall in venous pressure on walking responded less well to operation than those in whom some reduction took place. He advised against operation in cases in which no fall occurred.

White and Warren (1949) studied the possible protective effects which deep vein

ligation might have against high pressure caused by straining. Although it was difficult to obtain standard conditions of strain in order to compare effects before and after operation, they concluded that deep venous ligatures did not act as dams protecting against excessive rises in pressure. If the ligatures gave any help against the effects of straining it was probably by improving the efficiency of the venous pump so that the high pressure produced could be more rapidly lowered.

DeCamp and his colleagues (1951) in New Orleans have studied venous pressures using a water manometer. They found like other workers that the venous pressure in the legs of normal people was reduced during exercise. In 11 post-phlebitic limbs a less-marked fall in pressure occurred and in 4 patients there was actually a rise in pressure on exercise, suggesting obstruction to the venous outflow and contra-indicating ligation of veins The changes in venous pressure on exercise were measured in two patients after tying the superficial femoral veins and were found to be smaller than before. On the basis of these findings after deep vein ligation they have abandoned the operation. This conclusion is at variance with that of Walker and Longland (1950). It is unfortunate that DeCamp and his associates only studied two patients after operation for it seems that in a proportion of cases function is improved and further work is necessary to decide which patients may benefit.

A possible explanation of the variable results is that some competent valves must be present in collaterals if ligation of the main incompetent channel is to improve function. The finding of Walker and Longland that improvement in function only took place after operation if there had been some reduction in pressure on walking beforehand supports this explanation.

The pressure changes on exercise have also been studied in the deep veins of the thigh and popliteal region and they are interesting because they differ from the changes at the ankle or foot. Veal and Hussey (1940), using a water manometer to measure changes in normal popliteal veins, found fluctuation during exercise but no change in the mean pressure. Sturup and Hojensgard (1950), using a capacitance manometer and a small catheter passed through the short saphenous veins into the popliteal or deep femoral vein of patients with primary varices or post-thrombotic disease of the deep veins, also found small fluctuations but no change in mean pressure on exercise They knew that the pressure changes in the lower leg differed from those in the thigh and popliteal fossa for they had previously studied them in other patients using the same instrument (Hojensgard and Sturup, 1949).

A constant pressure in the deep veins of the thigh is quite compatible with normal function, for Barcroft and Dornhorst (1948) have shown by a plethysmographic method that the muscle pump of the lower leg can work efficiently against a pressure as high as 90 millimetres of mercury.

PHLEBOGRAPHY

There have been several recent studies of the deep venous circulation of the leg using radio-opaque injections. These have been either "ascending phlebograms" when the dye was injected distally and allowed to flow in the natural direction towards the heart, or so-called "retrograde phlebograms" when the dye was injected against the stream of blood. Dow (1951) has used a method in which Diodone was injected into a vein on the dorsum of the foot and directed into the deep system by means of bandages compressing the superficial veins. The flow of blood and dye was arrested at knee level by a tourniquet until the films of the leg were exposed. The tourniquet was then removed and radiographs taken of the thigh. The patient lay supine during the procedure.

This method was used to investigate 62 patients with oedema and ulceration of the leg. The results are shown in Table III.

TABLE III

Past history of deep thrombosis	*State of deep veins on phlebography*	*Number of patients*
No	Normal	30
No	Abnormal	6
Yes	Normal	15
Yes	Abnormal	11

Phlebograms were interpreted as abnormal when there was tortuosity and irregularity and absence of valves in the deep veins and free connexions with the surface veins. In no case were the deep veins actually blocked. Dow concludes from this that ablation of superficial varices should always be of benefit to patients with post-phlebitic ulceration. His own data suggest that there is no danger in removing them but there is other evidence to suggest that this may not always be so. Manometric studies by DeCamp and his colleagues (1951) showed that in some patients there was a definite obstruction to venous outflow and that blocking more veins would increase it. Walker and Longland (1950) showed by ascending and retrograde phlebography that the femoral veins were blocked in four of the patients in their series. Hojensgard (1949) also demonstrated deep blocks in some of his patients. It is not safe to assume that the deep veins are always patent after deep thrombosis. Their patency must be proved in each case before additional veins are obliterated.

Pitfalls in interpreting phlebograms are shown in the work of Moore (1951) in which a technique of ascending phlebography failed to show valves in a high proportion of cases. This was interpreted as actual absence of valves which was in turn taken as the cause of the disease. Murley (1951), commenting on Moore's work, said that he himself had found it possible to demonstrate valves in normal veins by phlebography in only a small proportion of cases. He found also by anatomical dissection that the ampullary bulges near the valves which are necessary to show them in radiographs existed in very few veins. The failure of valves to show in phlebograms, therefore, did not mean that they did not exist. Hojensgard (1949) was able to outline valves more efficiently if the limb was held vertically instead of horizontally.

Dow (1951) rightly insists on rigid criteria for the diagnosis of valvular incompetence. His figure of 11 demonstrations of abnormality in 26 patients with post-thrombotic disease is probably as high as can be detected with certainty by phlebography. As a method of detecting abnormal venous function it is less sensitive than manometry.

When retrograde phlebography was examined by Dow it proved to be no more sensitive than the ascending method. In only 7 out of 23 normal cases tested by injection down the femoral vein was the dye stopped by the nearby valves. In all the rest it passed well down the superficial or deep femoral veins.

He considers that the same criteria of abnormality must be used in interpreting both retrograde and ascending phlebograms. Bauer (1948), using a similar technique, observed retrograde flow in the femoral veins of 30 patients with superficial varicose veins and concluded that the valves were abnormal. Dow regards this conclusion as unjustified because of his own findings in normal limbs.

Angiographic methods in general have proved less sensitive in detecting circulatory abnormalities than manometry because the information which they give relates more to structure than to function.

Interpretation of phlebograms is often difficult and unless caution is observed misleading deductions may be made. They are most useful as an adjunct to other

methods of investigation, particularly when doubt exists about the patency of deep veins and/or the diagnosis of old deep thrombosis. In the latter case definite structural change should be visible before the diagnosis is made, mere retrograde spread past valves is not enough.

STUDIES OF THE LYMPHATIC CIRCULATION AFTER VENOUS THROMBOSIS

Lymphatic stasis due to destruction or incompetence of the lymph vessels has been often postulated as a cause of the morbid changes recurring in the leg after deep venous thrombosis. Usually it is suggested that the lymphatics have been injured by infection during an initial attack of thrombophlebitis or else through subsequent attacks of infection and inflammation in ulcers on the leg. There has been no direct evidence to support this hypothesis because of the difficulty of studying lymphatic function in man. The studies of the protein content of oedema fluid from post-thrombotic limbs by Ratcliffe (1950), which have already been mentioned, provided no evidence to suggest that lymphatic obstruction could be a major factor in the oedema formation Some data have recently been obtained by Kinmonth (1952) on the state of the main deep lymphatic trunks of the leg in patients suffering from the after-effects of thrombosis in the deep veins. Dye solution injected into the sole of the foot outlined the lymphatic trunks lying on the popliteal vessels. The deep lymphatics were shown to be patent in eight out of nine patients studied. This, however, does not exclude disease of the smaller lymphatics in the immediate region of ulcers. More information on the subject obtained by this or other methods would be of value.

TREATMENT OF THE VENOUS DISORDERS

In the last twenty years many different methods have been used to treat hypostatic ulcer of the leg. To begin with, infection was a problem which made healing a slow process and sometimes prevented it altogether. This was often so despite treatment by rest and elevation of the limb. Many of the earlier reports, therefore, dealt at length with the efforts made to heal the ulcer rather than to keep it healed after this had been achieved. Since the introduction of the sulphonamides, penicillin and other antiseptics, emphasis has changed to keeping the surface covered by healthy skin after healing has been achieved. The efforts made to overcome the factors tending to recurrence of the ulcer fall into four classes (1) external support by bandaging and other means, (2) skin grafting and allied measures, (3) sympathectomy; and (4) vein ligation.

External support

Dickson Wright was the first vigorous advocate of external support as a means of treating varicose ulcers. He described in 1930 how he used Elastoplast adhesive bandages applied to the feet and legs of the patients No dressing was applied under the bandage and the patient was allowed to walk and carry on normal activities. After the pressure of the bandage had reduced the amount of swelling and when healing was complete visible varices were injected. If the patient had suffered from deep venous thrombosis in the past the supporting bandages had to be worn for life. The method was an advance on previous ones because it succeeded in healing ulcers without long periods of rest in bed. Its disadvantages in the early stages were the unpleasant effects of discharges soaking through the bandage and later, after the ulcer had healed, the reaction of the skin to prolonged contact with the adhesive. This often resulted in dermatitis. Dickson Wright in his early reports does not men-

tion the recurrence of ulceration under the bandages but other workers have found that it occurs. Figures are not available to show how many post-thrombotic ulcers remain healed with this treatment, but in 1950 Wright reported that many of his patients had remained healed for ten years.

Because adhesive bandages resulted in such unsatisfactory features as skin irritation and the accumulation of discharges from the ulcers, other workers have used elastic bandages which can be changed frequently, and they have kept the ulcer clean and covered by dressings of various kinds. Scandinavian workers have paid particular attention to this mode of treatment and Birger (1947) and Bisgaard (1948) have reported their methods and results. Under the Bisgaard regimen the patient is shown how to dress the ulcer and bandage the leg himself. The oedematous indurated areas around the ulcer which he terms "infiltrations" are subjected to gentle massage and particular local support under the bandage by the application of suitable pads. Perhaps the most important aspect of the routine is the way in which the patient is taught to fend for himself and is shown that he can carry out the details of the treatment.

It is quite evident that good results can be obtained by conservative measures alone, and this must be remembered when judging the results of more active methods in which bandaging is often used as well as operation.

It is unfortunate that none of the workers who have used conservative methods has reported the results after a given length of time in a form which could be used for statistical comparison with other methods. A study giving the number of ulcers remaining healed after a given time (five years would be a suitable period) would be most valuable not only as a test of the value of conservative measures but for comparison with operative treatments which often employ conservative measures as an adjunct.

Skin grafts

The second method used in trying to achieve permanent healing has been the use of skin grafts. This gives healthier cover for ulcers than the mere ingrowth of scar epithelium from the edges. Excision of the scar tissue under the ulcer also helps to achieve a more permanent result. Homans in 1917 differentiated ulcers due to primary superficial varices from those following phlebitis and deep thrombosis. He advised that the latter type of ulcer should be excised with its underlying scar formation down to healthy tissues, and also a surrounding area to an extent of at least 1 centimetre from the edge of the ulcer. "Thick" free skin grafts were then to be applied. This was a preliminary report and no information was given of the subsequent course of these patients.

Homans warned strongly against operations such as ligation of veins in the diseased "post-phlebitic" areas near ulcers. These areas should be excised or left alone.

Douglas in 1935 reported good results from excision and grafting of chronic ulcers which had failed to respond to Elastoplast bandaging. Neither he nor any of the other workers such as Trout (1929), Pennoyer (1934), or Brown and others (1936) who have used this method give statistics of long-term results which could be compared with those of other methods. De Takats in 1944 reviewed the results of 25 operations of excision followed by dermatome grafting; they were considered to be good in 23 cases and in general to be better than those following sympathectomy or femoral vein ligation. Unfortunately the period of time during which the patients were observed after operation was not stated.

Sympathectomy

Lumbar sympathetic ganglionectomy has frequently been used in the treatment of post-thrombotic ulceration of the leg to increase the blood flow in the diseased area

and diminish supposed stasis in the capillaries. It has sometimes been used alone but more often with other measures as well. Walker and Longland (1950) criticize it on two grounds—first because it abolishes the vasoconstriction which should occur when the patient stands, thus increasing capillary pressure and filtration; and secondly because of its effect on the veins which are forced to carry more blood and are dilated by the operation, thus decreasing the efficiency of the valves. Boyd (1950), however, is in favour of sympathectomy because it keeps the skin of the leg in a healthier state by drying it. He found that 50 per cent of his patients had recurrent ulceration within two years if treated by excision and skin grafting only, but that 90 per cent remained healed if sympathectomy was done as well. The patient's personal hygiene was thought to be important in preventing recurrence.

Vein ligation

Ligation of the main deep veins has been tried extensively in the last ten years in attempts to improve the circulation in limbs damaged by venous thrombosis. It was thought that ligation of an incompetent deep vein might have the same beneficial effect as ligation of a superficial one. Homans considered that the deep veins often became incompetent when they recanalized after thrombosis and in 1941 advised tying the femoral vein in suitable cases. Buxton and his colleagues in 1944 reported the early results of 21 operations from femoral vein ligation for old thrombosis. They found that most of the patients experienced immediate relief of pain but that the swelling became more marked for the first day after operation. The increased swelling persisted in seven patients. In 1945 Buxton and Coller reported the results on patients who were followed for periods up to two years after operation. Of 15 patients with ulceration two failed to heal and two needed excision and skin grafting of the ulcer as well as femoral vein ligation to make them do so. It was concluded that femoral vein ligation was of benefit to the patients with ulceration but not to those with oedema alone. Linton and Hardy reviewed their results in 1948. They had found femoral vein ligation alone unsatisfactory and therefore combined it with removal of the great saphenous vein and sometimes the small saphenous vein as well if the ulcer overlay it. They believe that the superficial veins are diseased as well as the deep ones but that oedema and induration often obscure them. Their method was applied to 84 limbs and the patients were followed for 1–16 months. In 80 per cent of cases ulceration had ultimately healed despite the fact that patients were sometimes discharged from hospital before the healing was complete. The failures were due to excessive scar tissue formation before treatment or to failure to remove an incompetent small saphenous vein underlying an ulcer. In 63 per cent of cases pain was relieved and induration disappeared. Oedema was improved in 45 per cent of cases. Glasser reviewed his experiences in 1949. He considered femoral vein ligation the best treatment. His cases were followed longer than Linton and Hardy's and assessed in a somewhat different way so that they are not strictly comparable. Of 34 patients with ulceration followed for 1–4 years after operation 23 remained healed, that is 66 per cent. Cassel's impressions of femoral vein ligation were less favourable (Cassel, 1950). Ulceration and oedema were not improved although some patients were relieved of pain. Only seven patients were studied and they had been selected for operation by phlebography. The dye was injected percutaneously into the femoral vein with the patient standing. Retrograde flow down an obviously ragged and diseased vein was taken as the indication for operation—a method which would tend to select only those patients with most severe venous damage—and this probably accounts for the poor results.

Bauer (1950b) has advocated ligation of the popliteal vein for what he terms the "lower leg syndrome" following deep venous thrombosis. The clinical features, such as ulceration oedema and induration, were taken as the routine indications for the

operation, but when there was doubt as to the role played by incompetent deep veins extra tests such as phlebography and manometry were done. The technique and interpretation of these tests is open to criticism. Phlebography was done by the retrograde method down the femoral vein and flow of dye below the knee was considered to show that the valves were faulty. Dow (1951) has shown that retrograde flow of dye may occur in normal veins and that tortuosity and irregularity of the walls must be present before they can be considered abnormal. Bauer's method of measuring popliteal venous pressure during the operation after slowly tilting the table is also open to criticism, for the workers quoted in the section on manometry have shown that the pressure in normal deep veins remains high until muscle contractions occur in the leg. Indeed, Sturrup and Hojensgard (1950) showed that the mean pressure in normal popliteal veins remained high even during exercise. It is probable, therefore, that Bauer's methods of selecting patients for operation may have allowed the inclusion of cases with less severe or extensive venous damage than those of other workers and this must be remembered when the results are compared.

In 1950 Bauer reported the results of popliteal vein ligation in 77 patients who had been followed for 1–2½ years. Sixty-three were considered cured because there was no recurrence of ulceration or pain. Fourteen patients had recurrence of the ulceration. Unfortunately it is not clearly stated whether all 77 patients had ulceration before operation: if it is assumed that they did the recurrence rate works out at 18 per cent.

Walker, who had selected his patients for popliteal vein ligation by the preoperative manometric test which he and Longland devised, reported the results of the operation in a group of 26 patients followed for 3–15 months after operation. Oedema had existed in 23 patients of whom 3 were cured and 11 improved. Pain was relieved in 16 out of 20 cases. Eleven patients had ulcers, 4 of which recurred during the period of observation.

Linton and Keeley in 1939 reported the results of a method of treating postphlebitic ulcers which used a different principle. Instead of tying a main incompetent deep venous trunk they tied the so-called "perforating" veins of the leg which pass from the superficial to the deep systems. Their procedure was first to heal the ulcer by bed rest, general measures and perhaps skin grafting, then 6 weeks later to tie all the "perforators" in the leg, 6–8 in number, after making a vertical incision and raising two large flaps of skin. The early results were most promising for only one ulcer had recurred in 17 cases followed for 12–18 months. In 1948, however, Linton and Hardy reported that the later results were disappointing: 45 per cent had recurred and the method was abandoned in favour of femoral vein ligation.

The results of different vein ligation operations are compared in Table IV. To simplify the comparison the effect on ulceration only is considered. It has been possible to compare only series in which healing was achieved at operation or soon after and the number of ulcers subsequently recurring was noted.

Roughly one-third of patients treated by deep vein ligation had recurrent ulceration of the leg during the first 18 months after operation.

Bauer's figures are better than the other workers', probably because of different methods of selection. In many of these studies the patients were treated by ancillary measures which must have helped. Rest in bed in hospital with extra care and cleaning of the limb, supportive bandaging after operation, are all measures which in themselves tend to heal ulcers and keep them healed as well as allaying pain. All these factors are uncontrolled. It is most unfortunate that no statistical study of patients treated by the basic conservative measures has been made for comparison with more radical treatment. In the absence of a control series the statistical results of deep vein ligation cannot be used to make a case for the operation although they may be compared with one another. The theoretical arguments for the use of the operation

still stand, however, and the physiological studies have shown that deep vein ligation helps the circulation in the leg in certain cases.

TABLE IV

TYPES OF VEIN LIGATION JUDGED BY FREQUENCY OF RECURRENT ULCERATION AFTER OPERATION

Treatment	*Authors*	*Number of cases recurring*	*Total cases*	*Per cent recurrence*	*Time followed in months*
Excision and skin graft	De Takats (1944)	2	25	8	Not stated
Skin graft plus ligation perforating veins	Linton and Keeley (1939)	1	17	6	12–18
	Linton and Hardy (1948)	22	49	45	Over 18
Femoral vein ligation	Glasser (1949)	11	34	33	12–48
Popliteal vein ligation	Bauer (1950)	14	77	18	12–30
	Walker (1950)	4	11	36	3–15

Conclusions

Most of the methods of treatment in use are still under trial and final conclusions cannot yet be given. From the purely practical therapeutic point of view and leaving out of consideration studies aimed at advancing knowledge, some general rules can be laid down.

1 All patients with symptoms due to past thrombosis in the deep veins need supporting bandages or stockings which must be worn constantly and permanently. This is necessary whatever operation has been done. In general, non-adhesive crêpe bandages are best. Old ones which have lost their elasticity must be discarded.

2. When oedema is the chief or only symptom, support is the only treatment indicated. Well-fitting elastic stockings are often better than bandages. Deep vein ligation or sympathectomy will only increase oedema.

3. When diffuse pain in the leg is the predominant symptom, popliteal vein ligation is to be considered. The results obtained by Bauer and others show that it helps this more than other symptoms. Preliminary tests by phlebography or pressure measurements are desirable.

4. All patients with ulceration require supporting bandages and allied measures on the lines suggested by Bisgaard (1948) whether or not operation is undertaken.

There is no good evidence that deep vein ligation or sympathectomy helps to achieve or maintain healing. Skin grafting accelerates healing and gives better cover than scar epithelium but post-operative support is still necessary to prevent recurrence. The most suitable cases are those in which the ulceration and induration are circumscribed Wide and deep excision is best and the free grafts should be of adequate thickness.

When ulceration, induration and eczema are widespread grafting is not indicated, and purely palliative measures of the Bisgaard type should be used.

LYMPHOEDEMA

Oedema of the lower limbs due to lymphatic obstruction caused by extensive malignant disease, infection or ablation of lymphatic tissue has often been described. Attempts at cure have usually been prevented by the very nature of the cause and they will not be considered here. Lymphoedema due to filarial infestation, although its treatment is like that of idiopathic lymphoedema, is not of importance in temperate climates.

Cases of oedema of one or both lower limbs called lymphoedema praecox, hereditary lymphoedema (Milroy's disease), idiopathic lymphoedema and other names make up a group second in size only to that due to venous disease.

The postulate that the swelling is due to lymphatic obstruction, although generally accepted, depends largely on negative evidence. The local venous circulation can be readily shown to be normal by ordinary clinical methods and by phlebography and manometry. No abnormality is found in the local arterial system. Drinker and his colleagues in 1934, however, showed that the oedema fluid in a case of lymphoedema praecox contained a high concentration of protein, which was strong evidence of lymphatic obstruction. Actual lymphatic obstruction has never been seen, although Homans (1936), exploring the pelvis of a patient with lymphoedema of the leg, found the lymph trunks lying on the iliac vessels to be smaller than normal and fibrotic in appearance. Certainly there is no absence of superficial lymphatics in the skin, for they can be readily demonstrated by the Hudack and McMaster dye-injection method. They are larger than those in normal skin but this is no evidence of obstruction because they are enlarged also in oedema due to causes such as cardiac failure or hypoproteinaemia where lymphatic obstruction plays no part (Kinmonth, 1948, 1952). Further work is necessary to show the nature and position of the lymphatic obstruction and perhaps even to confirm its existence.

Operations for lymphoedema

Operations for the treatment of lymphoedema fall into two classes. In one class of operation an attempt is made to restore lymphatic flow past the area where it is thought to be obstructed. Handley's threading operation, Kondoleon's fascial window and Gillies' bridge pedicle belong to this "physiological" group. The other class of operation aims at restoring the normal contour of the leg by excision of large amounts of swollen superficial tissues with subsequent replacement of skin by grafting operations.

The "physiological" group of operations for lymphoedema

In 1908 Sampson Handley described his operation of "lymphangioplasty" for swelling of the arm following mastectomy. Silk threads were inserted into the oedematous tissue under the skin with the object of forming new channels for the flow of lymph into healthy tissue whence it would be absorbed. The method was applied widely for different kinds of lymphoedema but the later results were disappointing and it fell into disuse.

Kondoleon in 1912 described an operation based on the assumption that the lymphatic obstruction lay between the superficial and deep drainage systems of the limb. It was hoped that excision of a window of deep fascia would allow drainage of lymph to occur from a subcutaneous tissue to muscle and thus reduce oedema of the limb. Most workers found the results to be disappointing. Sistrunk (1927), however,

believed that new blood and lymph anastomoses were indeed formed between the superficial and deep tissues but that the presence of irreversible change in the subcutaneous tissues prevented decrease in size of the limb. He therefore modified the Kondoleon operation to include wide excision of diseased tissue. An elliptical strip of skin, fat and deep fascia extending from the iliac crest down to the external malleolus was removed, slashes made in the underlying muscles and the skin edges sutured together. At a later stage the inner side of the limb was similarly treated. The limbs were greatly reduced in size by these operations but it was not claimed that they returned to normal.

The poor results from the original Kondoleon operation suggest that the success of Sistrunk's modification is due to mechanical removal of bulky tissue rather than to improved lymph drainage.

Gillies and Fraser reported in 1935 the results of an operation for lymphoedema praecox of the lower limbs in a girl. A large flap from the arm and forearm was transferred to the thigh and trunk in order to make a bridge of tissue containing normal lymphatics stretching from the area of defective drainage into an area of normal drainage into the axilla. Two principles were considered essential. The first was that the valves of the lymphatics in the graft should lead the lymph in the correct direction. To achieve this the distal part of the graft previously near the wrist was attached to the thigh, and the proximal part previously near the axilla was attached to the trunk. The second important principle was to ensure that the proximal part of the graft extended well into the area of normal drainage To do this it was necessary for the graft to reach into the area of axillary drainage which starts at the level of the umbilicus. Any graft attached to the trunk below the umbilicus would communicate merely with lymphatics draining back to the inguinal region which was thought to be involved in the disease process. The result of Gillies' operation was most successful but other workers have not repeated the operation, probably because of its magnitude. Mowlem (1948) used it in a drastically modified form Pedicle grafts from the chest and abdominal wall were used as bridges from thigh to lower abdomen. They did not reach above the level of the umbilicus and it is almost certain that the decrease in size of the thighs which followed was due to the excisional operation which he also performed on the patients' lower legs. Poth, who performed similar wide excisions of the oedematous tissues of the lower leg, noticed improvement in the thigh and considered it unnecessary to operate on the thigh as it always improved spontaneously after the leg was treated (Poth, Barnes and Ross, 1947)

Excisional operations for lymphoedema

The disappointing results of the physiological operations or their magnitude has led to their supersession by procedures aiming at excision of the diseased tissue followed by skin replacement. It has often been observed that the deep tissues of the lymphoedematous limbs are unaffected by the disease. The muscles and other structures below the deep fascia appear perfectly healthy. Sir Havelock Charles in 1912 advised excision of all diseased tissues down to the deep fascia followed by immediate skin grafting The excision should extend from healthy tissue proximal to the disease down to and including the dorsum of the foot. Charles's operation was neglected until improved methods of skin grafting and antisepsis made it easier. It has been reinvented several times in the last decade. Macey described in 1940 how he had treated the leg of a patient with lymphoedema praecox and the upper limb of another with congenital lymphoedema, using this principle but in several stages. The oedematous tissues were raised from the muscles which were then covered by Thiersch grafts. The oedematous tissues were replaced over the grafts for nine days to act as a dressing and then discarded. He reported in 1948 the results in seven patients followed from one to seven years. All did well except one patient who developed a stasis ulcer on the

graft. No external support seems to have been necessary after the first three months following operation. The photographs which he publishes of the long-term results are good evidence of the value of the operation.

Mowlem reported in 1948 the results of his treatment of ten patients whom he had followed from one to nine years after operation. One patient had oedema due to a tight scar encircling the leg; the other nine suffered from idiopathic lymphoedema. In each case the skin and oedematous tissue were cut away down to the deep fascia as in the Charles operation. The raw area was allowed to granulate and split skin grafts from some other region of the body applied after two weeks. It was thought advisable to have a thicker covering over the tibia and tendo Achillis, so in these regions a strip of the overlying skin was partly cleared of subcutaneous tissue without injuring its blood supply, and then replaced. The results were good.

Poth, Barnes and Ross (1947), McIndoe (1950) and Pratt (1951) have all reported on the results of operations using the Charles principle of excision followed by free grafting but differing in that skin from the actual oedematous area was used to cover the muscles. The healthy state of the skin of the swollen limb is often remarkable. Gross oedema and enlargement may exist for many years without deterioration of the skin apart from the hyperkeratosis and warty areas which appear in the later stages. Unless there is widespread inflammation and thrombophlebitis due to streptococcal infection, a far less usual happening in the present period of potent antiseptics than in the past, ulceration is unlikely to occur. The skin surface in lymphoedema presents a great contrast to that in venous disease where eczema, exudation and ulceration are frequent. The physiological reasons for this have already been discussed and it was concluded that the morbid changes in venous disease were due to stasis of the blood flow which stopped gas, electrolyte, water and protein exchange, whereas lymphatic obstruction merely interfered with water and protein exchange.

There are, therefore, good grounds both theoretical and practical for making use of local skin as split grafts. Poth, who used local skin as a split skin graft with good results observed a year later, comments that "it is questionable if local skin should ever be used because the lymphatic vessels of the dermis are involved in elephantiasis". In fact there is no evidence that the dermal lymphatics are blocked or deficient; they can be shown to be dilated very readily by the Hudack and McMaster test in which the dye enters and outlines them, if anything, more easily than in other forms of oedema.

That Poth's objection to the use of local skin is unfounded is also shown by the good results obtained from its use by McIndoe, Pratt and Poth himself.

McIndoe in 1950 reported the results of excision of subcutaneous tissue and replacement of the overlying dermis by a method which has given good results. The skin of the leg is dissected up as a large full-thickness sheet. No fat is left adhering to it and it is, of course, devoid of blood supply. A narrow strip of tissue is left in place over the tibia and the flap of dermis which has been raised is left attached along one side of it, not because the graft thus gains any blood supply but to avoid having to suture this edge in place afterwards. The underlying oedematous "lymph-bearing" tissues are then excised and the skin graft placed on the muscle and held in position by marginal suturing and a pressure bandage.

Pratt (1951) has used an electric dermatome to cut grafts from the affected limb before removing oedematous tissue. His method took him over 10 hours operating time to do one leg. Much of this time must have been spent in stopping bleeding and in suturing the grafts to one another and in place on the leg. McIndoe's operation, done in a bloodless field using a tourniquet, can be done in 2½ hours.

Pratt has found that grafts applied to the dorsum of the foot do badly because they often slough where they lie upon tendon. He advises against operation on the foot if it can be avoided, a view with which there is wide agreement.

One other operation of the excisional type must be mentioned. Homans in 1936

described an operation done in several stages in which pedicle flaps of skin with their blood supply were used to cover the muscle after excision of oedematous tissue. Survival of these thick grafts called for long intervals between stages to allow the blood supply to stabilize. This and other disadvantages have led to its supersession.

The operations for lymphoedema can be summarized as follows:

1. "Physiological" operations: Handley (1908), Kondoleon (1912), Gillies and Fraser (1935).
2. "Excisional" operations: (*a*) with cover by free grafts from elsewhere: Charles (1912), Macey (1940), Mowlem (1948); (*b*) with cover by free grafts from affected area. Poth, Barnes and Ross (1947), McIndoe (1950), Pratt (1951); and (*c*) with cover by local flap pedicles. Homans (1936).

McIndoe's modification of the Charles operation is the most logical and gives the best results of all the current methods. It has disadvantages derived from its excisional principles. It may be that a fuller knowledge of the disordered physiology of lymphoedema may lead to the design of an operation improving lymph drainage but less extensive than Gillies' method. Until this happens the McIndoe–Charles operation is the most generally useful.

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ADRENAL GLANDS

See also B.S P., Vol 1, p. 95, S. Key 12

Endocrine effects of the adrenal glands

Adrenaline and noradrenaline content of the adrenal glands.—West, Shepherd and Hunter

normal nictitating membrane of the spinal cat and by paper chromatography. The mean

the cortex. In 9 adult patients in whom the cause of death was hypertension the mean value for the relative amount of noradrenaline did not differ much from that found in the 26

of the aorta.

Cushing's disease

Tumours

Chromaffin tumour found at necropsy in a case of arterial hypertension.—Lumb (1951) describes a case, associated with persistent arterial hypertension, of an extremely rare chromaffin tumour (paraganglioma) arising from residual Zuckerkandl organs, and lying along the aorta near the origin of the inferior mesenteric artery. A woman, aged 40 years, was admitted to Westminster Hospital, London, in May 1950, with history of irregular severe headaches for many years, and of an unusually severe one the week before, with

improve When the patient was readmitted 2 months afterwards, her condition had deterior-

administered intravenously. Tachycardia ensued and the blood pressure rose to

of the aorta. The kidneys and adrenal glands appeared normal macroscopically; microscopically the kidneys showed slight pathological changes. In the tumour, nearly circular

demonstrated in this case.

Medullary and cortical tumours: diagnosis and treatment.—GRIMSON, EMLET and HAMBLEN (1951) describe developments in the diagnosis and treatment of the rare tumours of the suprarenal medulla, and of those of the cortex (or hyperplasia thereof) which are also rare The diagnosis of phaeochromocytoma, between the paroxysms of arterial hypertension, has been assisted by the use of histamine and other substances. The adrenolytic and sympatholytic

thoracic and transdiaphragmatic approach are stressed, the more suspicious side being examined first. An abnormal position of the gland must not be overlooked. Tumours may also be bilateral. At operation, it is preferable to explore the left side first because this permits of fuller examination of the abdomen, by means of a second incision through the diaphragm The two stages may be carried out together or separately. After the left side has

ment followed partial removal of tissue; in some cases death occurred from glandular insufficiency.

Grimson, K. S , Emlet, J R , and Hamblen, E. C. (1951). *Ann. Surg.*, 134, 451.
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ALLERGY

See also B.S.P., Vol. 1, p. 157, S. Key 20.

Clinical picture

Manifestations following procaine penicillin injection.—SPRING (1951) describes a case of skin purpura, nephritis, and the nephrotic syndrome developing following an injection of

nephrotic syndrome developed but subsided as a result of bed rest and amino acid therapy. The rash finally disappeared 6 weeks after the onset of the illness. No sensitivity to penicillin was revealed in skin tests. Nine months after discharge from hospital there was definite evidence that chronic nephritis had developed.

Spring, M (1951) *J Amer. med Ass*, **147**, 1139

AMOEBIASIS—LIVER ABSCESS AND PATHOLOGY OF AMOEBIASIS OTHER THAN INTESTINAL

See also B S P., Vol 1, p 172, S Key 23.

Treatment

Comparison of chloroquine and emetine.—HARINASUTA (1951) describes the treatment of amoebic liver abscess by means of chloroquine, which is 7-chloro-4-(4-diethylamino-1-methylbutylamino) quinoline The drug was administered by the mouth in a dose of 0 6

course of treatment was employed a satisfactory response was obtained in 19 out of a group of 28 cases. The general condition improved rapidly, fever subsided and abdominal pain was relieved There were 7 relapses and 2 deaths A second course of treatment produced successful results in 8 out of 10 cases The toxic effects of chloroquine therapy included nausea and

modation

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cases, but 2 patients needed more than 1 course of emetine In 5 cases the drug gave rise to pronounced arterial hypotension and to prostration. Harinasuta concludes that chloroquine is highly effective in relieving acute symptoms due to amoebic liver abscess. It is less toxic than emetine, and there is the additional advantage that it can be given by the mouth The drug is well tolerated, even in cases of hypotension and severe prostration With regard to the destruction of parasites, however, chloroquine is less potent than emetine.

Non-hepatic secondary amoebiasis

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liver direct. The shadow in this condition is often perpendicular and linear. It is in such conditions that there

ses, of which 49 showed

t. Of these, 16 showed

only involving the left

side

Harinasuta, C (1951) *Indian med. Gaz*, **86**, 137.
Schorr, S, and Schwartz, A (1951) *Amer J Roentgenol.*, **66**, 546

AMPUTATIONS

See also B S P, Vol 1, p 178, S Key 24.

Indications

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elimina

tions. C

of functioning limb as is possible. The indications for

effective as is the intravenous use of fluorescein. The use of radioactive isotopes for estimation of circulation in the leg is not as yet practicable for routine tests

Luke, J. C. (1951) *Canad med. Ass. J.*, 65, 343.

ANAESTHESIA—GENERAL

See also B.S.P., Vol. 1, p. 205, S. Key 26.

Maintenance anaesthesia

Cyclopropane: effects of raised airway pressure during.—PRICE and his colleagues (1951) report on the circulatory effects of raised airway pressure during cyclopropane anaesthesia in man. The results are based on a study of 12 patients undergoing operation under cyclopropane anaesthesia. The effects of raised airway pressure were observed while the patient was unconscious. Following induction with different methods the depth of anaesthesia was increased rapidly with cyclopropane and the airway pressure raised for the second time.

pressure during raised airway pressure in any subject. In 2 cases systolic and diastolic pressures decreased slightly. Venous pressure rose abruptly as increased pressure was applied to the airways of conscious, lightly or deeply anaesthetized subjects. As the airway pressure ... in the conscious subjects. In lightly

time. Further experiments indicate that the difference in arterial response to raised airway pressure appears to be caused primarily by a pronounced rise in intrathoracic venous and right atrial pressures which occurs during cyclopropane anaesthesia. An additional factor is the diminished transmission of airway pressure associated with anaesthesia.

Complications of endotracheal anaesthesia; laryngeal sequelae.—BARON and KOHLMOOS

ness. They were found to have a moderate degree of redness of the vocal cords and arytenoid mucosa with some irregularity of the posterior third of the cords. In none did symptoms persist for more than 5 days. An additional 16 patients complained of hoarseness but the vocal chords and arytenoid mucosa appeared to be normal. There was no

anaesthesia as being less formidable than it is because, although all of the ... developed some type of reaction to the endotracheal procedure, none developed any important sequelae. The study is further misleading in that the 80 patients included no children, in whom the serious sequelae more frequently happen. The cases presented by the authors

show that serious sequelae do occur and that the endotracheal method of anaesthesia is a formidable one. The cases show also that there are instances in which laryngeal or vocal

Baron, S. H., and Kohlmoos, H W (1951) *Ann Otol. etc. St. Louis*, 60, 767
Price, H L., King, B. D., Elder, J D , Libien, B H., and Dripps, R D (1951) *J. clin. Invest* , 30, 1243.

ANGIOMA

See also B S P., Vol **1,** p 264, S. Key 31.

Technique

Diathermy treatment of haemangioma and lymphangioma —AIKEN (1951) discusses the diathermy treatment of angiomas, an angioma being defined as a tumour composed of blood or lymph vessels. It is said that the primary factor in the development of an angioma is the persistence or part of the vascular network from which normal blood vessels are derived.

inically they
vessels con-
vessels and

contain lymph. Diathermy coagulates the tissues by the intense heat generated in the vicinity of the active electrode. To avoid charring the surrounding tissues, the needle is insulated except at its tip, and in this way the current is delivered only to the spot which requires treatment, thus avoiding damage to the normal structures As an anaesthetic, the author uses thiopentone intravenously for adults and ethyl chloride or Trilene for infants.

intensity, and states that it is most important that it should be applied only for a matter of 2–5 seconds at each point

Surgical removal —Remarking that the results of treatment of port-wine marks are usually unsatisfactory, GREELEY (1951) recommends the excision of these angiomas Either (1) multiple partial excision with closure, by suturing over the adjacent undermined skin, or (2) single excision and grafting may be used, the former gives a better cosmetic result. Cavernous angiomas are often less vascular than they seem For those which are soft and very vascular,

growth of tissue is "sculptured down", healing takes 3 or 4 weeks and the lesion does not recur

Aiken, D (1951) *Brit med J* , 2, 1123.
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ANTHRAX

See also B S P , Vol **1,** p 274, S Key 37.

Treatment

Chloramphenicol in treatment of cutaneous anthrax.—It has already been shown by McLean that chloramphenicol will inhibit the growth, *in vitro*, of *Bacillus anthracis* when in a con-

centration of 5 *micrograms per millilitre* CLARKE (1952) now reports the successful treatment of 4 cases of cutaneous an[illegible]
source, an infected cow, of [illegible]
together with arsenic. One [illegible]

[illegible]

any clear indication as to which is the best treatment. Chloramphenicol seems to be at least as effective as penicillin sulphadiazine and arsenic combined, for 4 patients responded to the new treatment in a gratifying manner.

Clarke, P. S (1952). *Brit. med J.*, **1**, 86.

ARTERIES

See also B.S P , Vol. 1, p 327, S. Key 37.

[illegible]

[illegible] ase [illegible] he [illegible] of [illegible] ght [illegible] ght
kidney was demonstrated by retrograde pyelography. After an intravenous injection of [illegible]

[illegible]

and the blood pressure became normal. Microscopical examination of the renal artery [illegible] The authors believe that the case [illegible] o-angiitis in a woman which caused [illegible]

Spasm

Physiology and relief of traumatic arterial spasm.—The arteries most affected by spasm are the larger ones in the extremities, and after local trauma they may remain in spasm sufficiently long to produce ischaemic muscle changes or gangrene in that limb. KINMONTH [illegible] in diameter of the contralateral femoral artery can be produced [illegible] his occurs even after bilateral [illegible] to show that a fall in blood [illegible] action, yet [illegible] oral artery, [illegible] number of [illegible] A 2·5 per cent solution of [illegible] Caffeine, [illegible] per cent papaverine is applied for a few minutes and if necessary a 1 per cent solution run down a polythene tube after the wound has been closed. It is also important to treat surgical shock so that the blood pressure is adequate.

Aneurysm

Resection of descending thoracic aorta.—A case of resection of the descending thoracic aorta for aneurysm is described by LAM and ARAM (1951). A white male aged 56 years was

scapular region; the heart was normal in size and there were no murmurs The blood pressure was 183/70; serological tests resulted as follows: Kline exclusion test, ++++, Kolmer, 10,000, Kahn and Eagle, negative. The radiographic appearances suggested evidence of "a large aneurysm involving the descending aorta with marked destruction of the adjacent vertebrae". It was decided to perform "recision of aneurysm" and "replacement with homo-

aneurysm by the use of the homograft was successful, but the patient died after 3 months from sepsis occurring in the old aneurysm, which had been left *in situ* Temporary partial paralysis occurred in this case post-operatively. Experimental work on dogs showed that ligation of all the intercostal arteries rarely caused spinal cord ischaemia, and the complication was, as a result, ascribed to excessively prolonged clamping of the aorta.

Dissecting aneurysm of abdominal aorta with secondary renal dysfunction —KONTOFF and SEARS (1951) report on a case in which renal disease was simulated by a dissecting aneurysm of the abdominal aorta. The patient was a male, aged 70 years, who experienced a sudden sharp pain in the back. At first it was believed that the patient had strained a muscle. Within 7 hours, however, the pain had radiated to the left flank and abdomen. There was abdominal distension, with tenderness on palpation of the left upper quadrant, left flank and left costovertebral angle. Urological investigation failed to reveal any evidence of renal calculus, but retrograde pyelograms showed displacement of the left kidney and ureter by a large retroperitoneal mass. The patient died 3 days later and the diagnosis of rupture of a dissecting

muscle

Kinmonth, J B. (1952) *Brit. med J*, 1, 59
Kontoff, H A, and Sears, B R. (1951) *J Urol*, 65, 364.
Lam, C R, and Aram, H H (1951) *Ann Surg*, 134, 743.
Malisoff, S, and Macht, M B (1951) *J. Urol*, 65, 371.

ARTHRITIS—SURGICAL CONSIDERATIONS

See also B.S P, Vol 1, p 371, S Key 38.

Orthopaedic appliances

Acrylic splint for the hand —KELLY (1951) describes an acrylic splint for the arthritic hand.
damag
flexion
phalan
finger,
allow evaporation of sweat. The splint should be worn during the night and as much as possible in the daytime Assiduous flexion exercises, controlled by the splint, restore a fair amount of flexion to interphalangeal joints, even in long-standing cases. Patients can be more readily persuaded to wear the splint than to wear appliances which aim at restoring movements by elastic traction of spring pressure.

Kelly, M (1951) *Med J Aust.*, 2, 229

ARTIFICIAL LIMBS

See also B.S.P., Vol. 1, p. 407, S. Key 39.

Preparation of stump for artificial limb

Use of leg pylons.—It has been stated that pylons, used after leg amputation, have serious disadvantages, but BLAU, PHILLIPS and ROSE (1951) disagree. They have used them for 4 years and found no unnatural gait with circumduction of the stump, no malformation of the stump and no complaint of weight or unsightliness by the patients. In the series reported on 31 patients received these pylons which were cheap and easy to make, using Celastic, a synthetic plastic. A plaster cast is made of the stump, and when dry plaster is applied on it to form a mould, in which, later, the bucket is shaped from Celastic strips and horsehide. The peg is fixed to this by means of strip metal, which is previously riveted to the bucket. Soon after amputation, the patients being still in bed, exercises are begun to maintain strength and, if necessary, whirlpool treatments are used to favour wound healing Neither pounding nor massage with alcohol, said to be valuable in hardening the stump, was ever required. In many cases patients returned to work soon after injury so that the economic saving was [illegible] ...ket [illegible] he [illegible] ly.

Blau, L., Phillips, J. J., and Rose, D. L. (1951). *Arch. phys. Med.*, 32, 585.

AUTONOMIC NERVOUS SYSTEM—ARTERIES

See also B.S.P., Vol 1, p. 466, S. Key 45.

Operative procedures

[illegible] —COSTON (1951) [illegible] visual failure due to vascular occlusion and in those of cerebral origin.

Coston, T O. (1951). *Amer. J. Ophthal.*, 34, 1289.

BASAL METABOLISM

See also B.S.P., Vol. 2, p 45, S. Key 49.

[illegible] metabolism in health

[illegible] of interferometric studies relating [illegible] on the basal metabolic rate. The [illegible] umed [illegible] ed as [illegible] ment [illegible] when [illegible] eased [illegible] neans [illegible] enyl- [illegible] dium. [illegible] 15-30 [illegible] s are [illegible]

Rinne, H. J. (1951). *Ann. Med. intern. Fenn.*, 40, 251.

BLADDER—INFECTIONS

See also B.S.P., Vol. 2, p 103, S. Key 54.

Treatment

Abacterial cystitis of possibly spirochaetal origin.—CZEKALOWSKI and HORNE report on 3 cases diagnosed as abacterial cystitis and on the isolation of a recognizable spirochaete from the urine in one case Abacterial cystitis shows severe local symptoms (dysuria, frequency

taneous cure or persistence for months or years. Neoarsphenamine gives dramatic and rapid relief, irrespective of the duration of symptoms. Arsenoxide (Mapharside) and quinquivalent arsenicals are also effective, and streptomycin and aureomycin may be useful. It is suggested that the causative organism may be a spirochaete. Three typical cases are described, which were successfully treated· Case 1 with neoarsphenamide; Case 2 first with arsenoxide with

of urine from any of the patients

Czekalowski, J. W., and Horne, G. O (1951). *Brit. med J.*, 2, 879.

BLADDER INJURIES

See also B S P., Vol. 2, p. 114, S Key 55

Aetiology and operative treatment

Injuries of the female bladder.—RUSSELL (1951) divides the aetiology of injuries of the female bladder into three groups, namely (1) following labour, (2) following trauma, including

vesical and urethral fistulae, intermittent incontinence does not exclude a fistula. The minute elusive fistula can be detected by placing cotton-wool swabs in the vagina and filling the bladder with a dye. Cystoscopy is essential for the study of the relation of the ureteric open-

small, with thick mobile vascular margins, cauterization may be employed. (2) Vaginal closure in layers is best employed when plenty of healthy tissue is available and some prolapse is associated. Good mobilization of the bladder and not too tight

bladder drainage

Russell, C. S (1951) *Edinb. med. J.*, 58, 437.

BLADDER—NEUROGENIC DISTURBANCES

See also B S P, Vol 2, p 123, S. Key 56.

Treatment

Surgical techniques which give relief in painful conditions.—After a brief outline of the innervation and physiology of the bladder, BOURQUE (1951) gives a description of the surgical

and the second being inferior, parasympathetic, coming from the erector nerves. In order to relieve the pain and frequency of these patients, operation must consist in resection of the hypogastric nerves, and of the erector nerves, and removal of the hypogastric ganglion where these nerves enter it. By a transperitoneal route, which is the route of choice, although a retroperitoneal or sacral route may be used, the presacral nerve is located and sectioned on

If the patient is a bad surgical risk, infiltration of the hypogastric ganglion with Novocain, and later with 95 per cent alcohol, can be performed by the perineal or sacral routes. If the

enced no relief

Bourque, J. P (1951). *J. Urol.*, 65, 25.

BLADDER—TUMOURS

See also B.S.P., Vol. 2, p 140, S Key 58.

Aetiology

Carcinoma of the urachus.—HURWITZ, JACOBSEN and OTTENSTEIN (1951) report on 2 cases of carcinoma of the urachus (the medial umbilical ligament), thus bringing the total reported to date to 54 cases. Case 1, a man aged 63 years, had had gross haematuria with hourly nocturia for 2–3 months, and intermittent haematuria for 3 years Cystoscopy revealed a reduced vesical capacity and an infiltrating sessile tumour covering the anterior bladder wall.

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Results of treatment

Analysis of 135 consecutive cases.—ROYCE and ACKERMAN (1951) review the clinical, therapeutic and pathological aspects of 135 consecutive cases of carcinoma of the bladder after a 5-year follow-up, to determine the late results of conservative treatment. Of these

year 4 months)
In grade III (25

areas were patchy in distri-

year 1 month) the papillary

ias (average survival rate 7 months); these were more malignant than the *transitional-celled tumours*. A *further 12* tumours were undifferentiated or unclassifiable (average survival rate 6 months). The size

cases). No total cystectomy had been performed. The treatment in general was satisfactory only for the tumours of low-grade malignancy. The authors emphasize that biopsies of bladder tumours should be as large and as deep as possible, because their malignancy varies in different areas

Hurwitz, S P., Jacobson, E. B., and Ottenstein, H. H. (1951) *J. Urol.*, 65, 87.
Royce, R. K., and Ackerman, L. V. (1951) *J. Urol.*, 65, 66

BLOOD PRESSURE—HIGH AND LOW

See also B S P., Vol. 2, p 189, S. Key 61.

High blood pressure

Aetiology essential hypertension due to aberrant renal artery—MARSHALL (1951) considers that a high degree of correlation exists between essential hypertension and the presence of an aberrant renal artery. The author describes an investigation in which 400 necropsies were performed in order to ascertain whether aberrant arteries were present. The incidence of enlargement of the heart was noted, and search was made for hyaline changes in the renal arterioles Clinical records were studied for evidence of raised blood pressure. Aberrant

be established between hypertension and the type or number of aberrant arteries. As for the mechanism whereby an aberrant artery produces high blood pressure, it is suggested that a functional change occurs, with the production of relative anoxia of the cortex of the kidney It is known that infection may supervene in cases of hydronephrosis and other forms of stasis Furthermore, arterial hypertension and pyelonephritis may coexist with aberrant

of survival of 5 years or more was observed after all complications except cerebral vascular accidents, papilloedema and nitrogen retention. In cases showing both cardiac hypertrophy and angina pectoris the average length of survival was 7 years, but with papilloedema it was only 1 year

Treatment with hexamethonium compounds—The use of hexamethonium compounds in

order partially to circumvent the vagaries of the hypertensive patient, as well as the tendency to exhibit a drop in blood pressure after rest in bed and in hospital surroundings, the cases were divided arbitrarily into 3 groups. In the beginning, almost all the patients were given hexa-

The development of tolerance to the drug by some patients suggests that intermittent treatment may be better than continued therapy.

Treatment of essential hypertension by sub-total adrenalectomy.—Having suggested that thoraco-lumbar sympathectomy is not very helpful in essential hypertension, ZINTEL and his colleagues (1951) propose that subtotal adrenalectomy should be given a trial. They

purpose In 1949 the authors began to remove one gland completely during the second stage

improved. When nine-tenths of the other gland were also excised, however, the blood pressure fell to normal and remained so for a year. No adrenocortical substitution therapy was needed. The cause of the improvement could not be definitely attributed to any one

renal damage had both glands removed entirely; in the phenolsulphthalein test of liver function, both had an excretion of less than 5 per cent in 15 minutes Most of these cases were thought unsuitable for sympathectomy. A two-stage operation was preferred, and in the second various adrenal hormones have been required as well as sodium chloride. In discussing the patients operated more than 4 months earlier, several cases are described in which the blood pressure had remained normal continuously or intermittently for 6-12 month

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abnormal Renal function improved after operation, but further observation is needed to assess the results of this new procedure. The authors think that subtotal adrenalectomy may be most useful as an adjunct to sympathectomy and splanchnicectomy.

Treatment of essential hypertension with hexamethonium bromide.—MURPHY (1951) describes the oral and parenteral use of hexamethonium bromide in the management of 43 cases of arterial hypertension. The series consisted of 15 males and 28 females aged 30-69 years, and the duration of treatment ranged from 6 weeks to 11 months. In each instance preliminary tests were made for sensitivity to the drug. Then the patient was given 0·25 ... dually to a ... lose of 200 ... al effective ... injection. ... rred in 26 ... siness and ... ded visual ... and emotional ... d intercurrent ... n reducing the ... was abolished ... author denies ... also been ob-

Fullerton, C. W., and Milne, I. G. (1951) *Canad. med. Ass. J.*, 65, 302.
Marshall, A. G. (1951). *Lancet*, 2, 701.
... *J.*, 42, 421.
... ffers, W. A., Hafkenschiel, J. H., and Lukens, ... 34, 351.

BLOOD TRANSFUSION—PRACTICE

See also B.S.P., Vol 2, p 195, S Key 62.

Complications

shivering and a temperature rise to 38·7° C. No further reaction followed transfusion from the third donor The development of oliguria and haemoglobinuria confirmed the impression that a haemolytic reaction had occurred, but the patient recovered uneventfully. On re-checking the specimens of blood and cross-matching the patient's serum with the cell suspensions of the first and second donors, Rh, M or N, H, Jobbins, Kell and Cellano antagonisms were excluded. A Lewis antagonism was suspected because the patient was a secretor, the first donor a non-secretor, and the second donor a secretor. On performing the saliva inhibition test, no agglutination reaction occurred when the patient's serum was mixed with saliva of a secretor and with red cells from the first donor. The factors C^w, S, P and Duffy were excluded as causes of the reaction. The patient's serum was compared with a known anti-Lewis[A] serum, and the figures were found to be identical The authors have learned of the occurrence of similar transfusion reactions; one was reported in the literature. They conclude that recent advances in the knowledge of antigens in human blood indicate that blood transfusions should not be contemplated as routine procedures, but regarded as treatment requiring the closest consideration.

De Vries, S I, and Smitskamp, H S. (1951) *Brit. med J.*, **1**, 280.

BONES—ERRORS OF DEVELOPMENT AND GROWTH

See also B S P., Vol 2, p. 258, S Key 67.

Polyostotic fibrous dysplasia

precocious puberty was not observed, nor was there any anomalous pigmentation of the skin Significant changes were not detected on biochemical examination of the blood.

Hobaek, A. (1951). *Acta radiol., Stockh.*, **36**, 145

BONES—METABOLIC DYSTROPHIES

See also B S P, Vol 2, p. 279, S Key 68

(1951) discusses changes in the

of their constant subjection to traumatic influences. In renal osteodystrophy ...

benign lesion. Leontiasis ossea usually affects the upper part of the face, although the mandible may be involved; the histological picture is more in keeping with fibrous dysplasia than with Paget's disease. In the jaws Paget's disease usually affects the maxilla; the radiograph shows a hazy ground-glass appearance; many patients complain of atypical facial neuralgia. After an artificial menopause, acute alveolar atrophy sometimes develops. Jaw ...

dren may ...
the disease ...
cinoma or ...

Cahn, L. (1951). *Ann. R. Coll. Surg. Engl.*, 8, 115.

BONES—NEW GROWTHS

See also B.S.P., Vol. 2, p. 298, S. Key 69.

Benign tumours

Osteoma of cranial bones treated surgically.—Hobaek (1951) describes the radiological ...

dysplasia. Of the author's patients, 7 suffered from osteoma of the cranial vault, and ...

and the zygomatic bones. Fibro-osteoma and osteoma occur at puberty, ... usually occurs before puberty. Differential diagnosis from osteitis deformans ... and biochemical tests may be required ... such as (1) diffuse meningioma and (2) ...

... as (1951) describe a rare case of neurofibroma of the mandible. A swelling was found in region 56 (left lower teeth 5 and 6) of the mandible, and in the mouth there was slight expansion of the buccal plate of bone in the same region. X-ray revealed a large radiolucent area beneath the apices of 56 and slight resorption

of apex of |5 and mesial apex of |6 A solid tumour was suspected, and at operation it was found under the apices of |56; on extraction of these teeth it was enucleated cleanly and easily. Tissues microscopically characteristic of neurofibroma were found: (1) a parallel arrangement of cells and intercellular fibres; (2) a loose mesh-work of cells showing numerous intracellular vacuoles or microcysts

Malignant tumours: primary

Aetiology and distribution.—WHITE and ELKIN (1951) report on 93 cases of primary

injuries mentioned were minor ones, such as contusions. The authors suggest that the evidence for trauma as a pathogenic factor is not convincing, and that the injury often focuses the attention of the patient on the bone lesion already present The low salvage rate in cases of primary malignant bone tumour, according to the authors, is influenced by certain significant factors In many instances there was an avoidable delay between the onset of symptoms and a correct diagnosis In addition, the relatively large number of patients admitted with invasion beyond the local site, or with widespread metastases, obviously dimin-

authors to be the treatment of choice for the types of tumour represented in their series of cases

Adamantinoma of jaws and other bones.—SCHULENBURG (1951) discusses the pathology

the many similarities with basal-celled carcinoma, the term basal-celled carcinoma of the

between the tumours is sometimes impossible. The author concludes by suggesting, as a definition of adamantinoma: "A malignant epithelial tumour, basal-cell in origin, character and behaviour, which may metastasize"

already affected by Paget's disease. Malignant transformation in osteochondroma is well known, and these tumours should be removed while presumed to be innocent Adequate

biopsy is of great importance. (b) Ewing's tumour occurs during the sarcoma age-period

tumour. (c) The third member of this group is malignant giant-cell tumour. This originates either as a tumour malignant from the beginning or as a malignant transformation in a previously benign tumour. The
easily defined. Out of 35 fiv
extra-periosteal sarcomas and 7
5-year survivals belonged to the chondro-sarcoma class of tumours. The extra-periosteal group were highly lethal as were Ewing's tumours and malignant giant-cell tumours. The majority of Paget sarcomas were of short duration. The author, discussing trends in the

sarcoma, which may originate from soft tissues in close proximity to the bone and invade it from without. The classification is completed by (5) osteoclastoma or giant-cell tumour of the bone, which is usually, but not invariably, benign. The 5 groups differ clinically and

diagnosis is based on signs and symptoms, radiography, biopsy and histological study. Radiography may reveal (a) varying degrees of bone destruction, closely resembling the appearances of some metastatic tumours, or (b) bone formation, which may be in the form of sclerosis, sun-ray spicules, longitudinal bone formation, or the reactive triangle described

Blackwood, H. J. J., and Lucas, R. B. (1951). *Proc. R. Soc. Med.*, 44, 664.

g. Engl., 8, 329.
Med., 245, 351.

BRAIN—ABSCESS

See also B.S.P., Vol. 2, p. 323, S. Key 71.

Surgical pathology

Otogenic cerebellar abscess.—Otogenic cerebellar abscess and some infections of the posterior fossa of the skull are discussed by DAVIS (1951). Cases of latent cerebellar abscess have often remained undiscovered until the track of suppuration in the mastoid-operation

abscess, lateral-sinus thrombosis, or meningitis is suspected or diagnosed. Study of the anatomy of the mastoid process, including the 3 groups of air cells (marginal, zygomatic, and deep retro-facial), shows the various possible paths of infection. Recorded cases and necropsy findings indicate that the cancellous bone of Trautmann's triangle is the most common path of infection to the posterior fossa. The reports of 125 necropsies of otogenic

tapped in the latent stage, before signs of cerebral compression appear; respiratory failure may occur in the comatose or drowsy patient.

Davis, E D D (1951) *J. Laryng*, 65, 646

BRAIN—INJURIES AND COMPLICATIONS

See also B S P, Vol 2, p 349, S Key 74, and *see also* Haematoma, page 238.

gravity of tissues or fluids. When they are limited to the perivascular spaces, they may be absorbed completely; but when the parenchyma of the brain is involved, they lead to traumatic encephalopathy, which is probably the basis of "punch drunkenness". In subarachnoid haemorrhage the red cells begin to break down after 24 hours, and it is the irritation from the resultant haemoglobin and breaking-down proteins which gives rise to the symptoms of sterile meningitis. Forces of acceleration and deceleration are the chief factors

the meningeal veins, the dural sinuses and the diploic veins.

Mechanics of cerebral trauma—For a proper understanding of the mechanics of cranio-cerebral trauma, MUSKAT (1951) points out that certain anatomical and physiological

t those of the base of

sily torn, they cannot

ones form important

brittle. The average

adult intracranial pressure, in the erect position, varies from 50 to 150 millimetres

Complications of brain injury—late

Visual disturbances.—In the experience of HOOPER (1951) the treatment of head injuries is often difficult and the
cases, the author noted
cases. The main groups
deterioration of vision (5
the globe (33 per cent).
unless there is loss of co
degree until 18 months later. Blurred vision may be due to purely ocular causes, such as traumatic chorio-retinitis; but when these are excluded it can be the result of paralysis of

haemorrhage, and in
the eye was complet
central and para-cer

points out that the best analogy is with the spinal cord. There may be concussion, contusion or laceration at any part of its intra-orbital course, five causes being listed: (1) derangement

d FREIMAN
ently non-
s of case-
n (1) The
ubsequent

the blow
o long; in
the authors
is, however minimal
(1) brain tumours,

(2) multiple sclerosis and (3) amyotrophic lateral sclerosis They conclude by stating that, in general, the evidence adduced to show that trauma is a cause of disorders in any of the three groups is not convincing.

Hooper, R. S. (1951) *Brit. J. Surg*, 39, 126.
Muskat, D A. (1951) *S. Afr. med. J.*, 25, 692, 706
Wechsler, I S, and Freiman, I. S. (1951). *N Y. St. J. Med*, 51, 2237.

BRAIN—NEUROLOGICAL INVESTIGATIONS AND SPECIAL TESTS

See also B S P., Vol. 2, p. 385, S. Key 75.

Special investigations

Angiography in diagnosis of brain abscess—SCHURR (1951) points out that it is often [illegible] has [illegible]

taken in antero-posterior and lateral projections, at 2, 4 and 8 seconds after percutaneous [illegible]

differentiated by this method from temporal-lobe abscess even in the absence of other signs or symptoms, as is shown by the author in some of his cases. In cerebellar abscess, neither the middle nor the anterior cerebral arteries are distorted Neoplasms are seldom so avascular with the exception of certain astrocytomas Repeated angiography can be performed without difficulty and may help to assess resolution; in 1 case it was carried out 5 times [illegible]

with the signs and symptoms of a cerebral tumour. Carotid angiography was performed during the course of the investigation The left common carotid artery was punctured at its bifurcation; 10 millilitres of a contrast medium were injected and angiograms were obtained. The patient lost consciousness a few minutes after the injection had been effected. With oxygen therapy, however, consciousness was regained after a period of about 10 minutes X-ray examination revealed that most of the contrast medium had been deposited in the [illegible]

No untoward change occurred during the course of this examination, but the condition of the patient gradually deteriorated and death took place 2 weeks later. Necropsy revealed the presence of a large multiform glioblastoma, generalized atheromatosis and a haematoma with thrombus formation in the wall of the left common carotid artery.

Intracranial venography of dural sinuses—RAY, DUNBAR and DOTTER (1951) describe new methods and uses of venography of the dural sinus To demonstrate the intracranial venous system satisfactorily, the following principal methods were used: (1) direct injection of contrast medium through a catheter passed into the anterior third of the superior sagittal sinus, (2) retrograde injection of the medium through a catheter passed into the basilic vein of the arm and upwards to the superior bulb of the internal jugular vein, (3) direct measurement of venous pressure in the superior sagittal sinus. The contrast medium—15 millilitres of Diodrast (35 per cent) or of Neo-Iopax (37 per cent)—passes rapidly backwards through the sinus to the torcular Herophili, and thence into the transverse sinuses and internal jugular veins. In the examination of 20 normal subjects, no real predominance in size or filling of either transverse sinus was found. In the author's opinion the standard x-ray equipment of most hospitals is suitable, and ureteral catheters, as used for retrograde

pyelography, are adequate. No special risk was demonstrated by the use of this procedure in 38 cases treated with successful results. In no case was a mistaken diagnosis made on the basis of the abnormal venogram, and findings were confirmed by subsequent craniotomy The most important uses of the method are considered to be demonstrations of complete or partial obstruction of the major dural venous sinuses by a neoplasm or thrombus. In cases of neoplasm, if the adjacent sinus is occluded, the radical extirpation of its occluded or invaded part, together with extirpation of the neoplasm, is safe; but resection of a patent superior sagittal sinus, except in its anterior third, or of a dominant transverse sinus, may [illegible]

been of limited practical value in diseases of the cerebral venous system, in 1 case an obstruction of the internal jugular vein was demonstrated.

Ventriculography and encephalography: use in control of radiotherapy.—Suggesting that assessment of the value of the irradiation of brain tumours is difficult for many reasons, PENDERGRASS and PHILLIPS (1951) consider the most important to be the lapse of time between treatment and examination at autopsy By using simultaneous encephalography and ventri- [illegible]
its [illegible]
the [illegible]
ing a lesion It also permits of the use of small apertures, thus sparing normal tissue. In one of their cases a right fronto-parietal tumour was diagnosed, and a transcortical incision revealed a tumour pa[illegible]
for section and judgec [illegible]
Under x-ray therapy [illegible]
were made very clear by repeated ventriculography. In another case a tumour was removed from the roof of the fourth ventricle. It was found to be a medullo-blastoma but, because symptoms recurred 3 months after operation, radiotherapy was used over the cerebellar region through 4 portals and over the entire cord through 3 portals. The patient's condition improved, but a ventriculo-encephalogram, made 8 months afterwards, suggested the presence of a basal subarachnoid or porencephalic cyst. Despite subsequent treatments the tumour continued to spread. At autopsy a fungating mass was found in the caudal part of the vermis. Three other cases are described in support of the value of the method used. Postero-anterior and antero-posterior exposures are taken in the horizontal and erect postures Lateral views in the erect and horizontal postures are also found most helpful, notably for lesions in the cisterna chiasmatis and middle fossa, where the first position is best. The variations in value of the photographs depend somewhat on the handicap to drainage in lesions of the posterior fossa It is thought that the use of radioactive isotopes [illegible] procedure.
[illegible] state that, even if a [illegible] ficult to demarcate. [illegible] active phosphorus
and potassium in cerebral tumours, [illegible]
mal brain tissue. In all 150 tumour: [illegible]
these were also demarcated. Radioa [illegible]
penetrate only about 7 millimetres [illegible]
identifiable through as much as 1·8 centimetres, so that the latter permits of less exact definition t[illegible] may be detected a few minutes aft[illegible] d. In a series of [illegible] rious errors accounting for the remainder Out of 30 cases investigated with radio[illegible] orus, only 1 tumour was missed and 1 falsely located, while 5 patients were found to be free from cancer. The radioactive material may be injected before and also during operation The apparatus is simple, consisting of a Geiger-Muller counter with a pre-amplifier and standard scaler or, more simply, a portable counting-rate meter with battery. Each reading may be [illegible] from a presumably innocent [illegible] were seen at necropsy. [illegible]

Uses of nuclear disintegration in diagnosis and treatment of brain tumour.—[illegible] reports that brain tumours take up P^{32} selectively and it may be detected *in situ* 12-24 hours later by using the Robinson type of probe Geiger counter. It is necessary to insert the counter

into the brain substar
phosphorus travel on
cerebral tumours Ra
in the scalp muscles.

Recently a positron coincidence counting circuit has been used to record unscattered

absorb slow-moving neutrons, their nucleus breaks up, and rapidly travelling *alpha* particles are emitted.

Boron is such a substance, and work is now in progress to find out whether B^{10} is of value in this reaction.

Idbohrn, H (1951) *Acta radiol., Stockh*, 36, 155

BRAIN—TUMOURS AND TECHNIQUE

See also B S P, Vol 2, p. 420, S Key 76

Case 2 the patient had a history of headaches 5 months prior to admission On admission the patient was semi-comatose. The temperature was 99 6° F There were marked neck rigidity and other neurological signs The cerebrospinal fluid contained 154 leucocytes per cubic millimetre A diagnosis of tuberculous meningitis was made, but there was no response

investigation Meningeal irritation, with associated meningitis clinically, may be caused by numerous agents These may act by causing a breakdown of nerve tissue. Acute demyelinating diseases may cause intense cellular reactions Aseptic meningitis following subarachnoid haemorrhage has been reported In a reported case of cerebral varix, symptoms of meningeal irritation followed each episode of rupture The authors point out that usually there is no increase in the cell count of the cerebrospinal fluid in cases of cerebral tumour; but, when tumour necrosis and myelin destruction around the tumour occur, an increase may result Softening of gliomas near the ventricles gives rise to a large number of polymorphonuclear cells in the cerebrospinal fluid

Treatment

Operative mortality analysis of operation and necropsy findings.—GRANT and SAYERS (1951) report on 891 cases of brain tumour recorded between 1931 and 1941. Of this series 89 tumours were verified at necropsy; the remainder at operation Of the patients who underwent operation during this period, 162 were still alive in 1950 An additional 35 patients had lived for 10 years or longer and then died, 16 from recurrence of the tumour and 19 from

intercurrent disease. An additional 41 had lived 5 years or more and then died. In the...

another lived 11 years and then died, probably from a recurrence; no patient in whom symptoms developed at the age of 7 years or younger survived beyond his fifth post-operative year. There were 38 cases of acoustic neuroma; 7 of the patients were alive in 1950. The authors report on the survival of other patients showing the rarer types of brain tumour; in their series these were present in fairly small numbers. The authors conclude that in this series 40 per cent of the tumours were relatively benign, and that careful surgical treatment should result in about 25 per cent of 10-year survival and in a 70 per cent return to work.

Operative mortality: danger of air embolism at operation.—REICHERT (1951) discusses the danger of air embolism in the removal of meningiomas arising along the superior sagittal or longitudinal sinus. This possibility has previously received only scanty recognition. Case 1, a woman aged 56 years, had a large and partially calcified meningioma. At operation, as the bone flap was being lifted from its attachments to the longitudinal sinus, the patient ...

had been completed. The patient made an uneventful recovery. The author states that parasagittal meningiomas may cause irregularity of the inner table of the skull overlying the longitudinal sinus. In these cases, unless the sinus is first occluded, the movements of a periosteal elevator may give rise to fatal air embolism.

Operative mortality. oligodendroglioma.—HORRAX and WU (1951) report on the post-operative survival of 26 patients with ... making special reference to the radical removal of tumour ... growing; mitoses and metastases are rare ... recorded by other workers show post-operative survival up to 21 years. In the authors' ... years. ... esent ... cases. ... asia, ... nd (8) ... hemi-spheres, 2 ... 1 operation ... ing 22 pati... just over 7 ... ranged from 10 months to 18 years. At operation, ... Oligodendrogliomas are stated ... are chiefly cerebral in origin and ... bellar oligodendrogliomas were found to have a shorter period of pre-operative symptoms. The authors conclude that radical excision of oligodendroglioma gives the best chance of survival.

Brown, I. ... 8, 459.
Grant, F.
Horrax, G.
Moore, S. (1951). *J. Neurosurg.*, 8, 480
Reichert, F. L. (1951) *J. Neurosurg.*, 8, 494

BRONCHIECTASIS

See also B.S.P., Vol. 2, p. 501, S. Key 81.

S... diagnosis ... 951) discuss aqueous ... probably the most

for bronchoscopic removal In other instances where the initial bronchograms are unsatis-

aqueous preparations are miscible On comparison with the iodized oils, the aqueous preparations offer the advantages of rapid elimination of the contrast substance (Iodopyracet), chemical stability, viscosity which may be varied and freedom from systemic toxic effect. Local tissue reaction is of lesser degree and shorter duration although this remains to be conclusively proved Technically, the aqueous media are, on account of their greater though transient irritant effect, more difficult to use This requires a well-distributed and more complete topical anaesthesia. The author describes details of the technique and presents illustrative bronchograms The literature describing effects of oily and aqueous preparations for bronchography on the lung parenchyma is briefly reviewed

Bronchography in infants and very young children —EEMAN (1951) discusses bronchography in the infant and very young child. The author outlines the history of bronchography and sums up the various dangers of this procedure in young children These consist of the risk of anaesthesia, the risk of the technical procedure of introduction of the opaque oil, also the risk of respiratory trouble due to the filling of the tracheobronchial tree and the risk of intoxication due to iodine As the author says, these risks undoubtedly exist but they are relatively remote and have not deterred the endoscopists from applying this diagnostic investigation to adults and adolescents with very useful results The author deals with each of these risks in turn and describes how they may be minimized To execute a correct filling and succeed in making serviceable radiographs requires a perfect technique, very fast work, a tremendous amount of patience and some luck. The author asserts that the special technical difficulties and the not infrequently poor results are not sufficient reason to neglect or discard a useful diagnostic procedure The author concludes by stating that no one will contest the necessity of a thorough examination in difficult or doubtful chest cases nor deny the usefulness of bronchography in those cases or assert that it is profitless in young children The special difficulties of these techniques or the eventually poorer results when applied to infants and young children as compared with adults should not deter us from trying and using them whenever indicated

Eeman, F G (1951) *Ann. Otol etc St Louis*, 60, 793
Norris, C M , and Stauffer, H. M (1951) *Ann Otol etc St. Louis*, 60, 802

BURNS AND SCALDS

See also B S P , Vol 2, p 518, S. Key 82

Morbid anatomy

Stress response in severe burns —The stress response in the severely burned has been investigated by EVANS and BUTTERFIELD (1951) ...

tage of being applicable also to the study of adrenocortical reserve in the surgical and convalescent stages The eosinophil depression was found to be closely related to the extent of burning injury, and was almost complete in 40–60 per cent burns A more extensive investigation was, therefore, made in a group of cases, to assess the natural stress response to burning and the correlation between various measurements, particularly between the eosinophils and cortical hormone excretions Eosinophil counts were made daily, and corticoid and

of compound F from the adrenal cortex. In analyses of individual cases, however, the

carried out by HAYNES, DEBAKEY and DENMAN (1951) Observations were made on 8 severely burned patients with involvement of 15–80 per cent of the body surface. Adequate fluid intake in the series was shown by regular urinary outputs of over 100 cubic centimetres per hour; nitrogen retention did not occur. The blood pressures were normal, and clinical shock was not observed. There was one death in the series, occurring 25 days after the burn; this was the result of severe uncontrolled infection with gangrene of an extremity, and renal failure was not a contributory factor Treatment, in addition to fluid and electrolyte therapy, included the use of plasma and whole blood; haematocrit determinations were kept at over ... of abnormal

plasma volume and the thiocyanate space. The results of the investigation show that severely ... a degree of renal functional compensation which

usually normal, and those made later, in one pa ...
factors which might produce the observed alterations include over-hydration, increased thyroxin, desoxycorticosterone acetate, pyrogenic response, hypoproteinaemia and adrenaline, but the exact mechanism is obscure.

Treatment

Burn wounds in children.—ALLEN (1951) describes the treatment of the burn wound in 1,000 hospital patients. The series comprised children aged 1–14 years; 605 were fresh,

Anaesthetics were never given, but some children received a rectal barbiturate ...
After removal of the clothing, under aseptic conditions in a warm room, a single layer only ... th a sterile dressing of

never used in face and neck burns, in patients who were not ...
or where there were contra-indications to general anaesthesia. Antibiotics were given only ... special cases, such as burns involving the upper respiratory tract, the axilla or the peri- ... They

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... ing in

... ss the

... bbits.

They describe the controls which they use and 4 experiments made ... (1) the effect of locally applied cortisone, (2) the application of the same dose of cortisone systemically, (3) the local application of cortisone to homografts on *specifically pre-immunized*

expression of the immunity reaction in some small and discernible degree, for, no matter

in some
vigour.
of the f
regressic
cells, which preceded destruction of the graft. The refusal of the patient's tissues to accept homologous grafts is thought to be akin to an antigen-antibody reaction.

ACTH therapy, clinical and experimental evaluation.—RAKER and his co-workers (1951) have made a clinical and experimental evaluation of the influence of ACTH on the need for fluid therapy of the burned patient. The problem was studied by 5 different methods of approach. (1) the effect of burns on the rate of lymph flow and on the protein content of

were made of the contents of blisters in several patients treated with ACTH; and (5) observations were made of a number of clinical cases of burns treated with ACTH in the hours immediately following the injury. The investigation failed to produce any evidence which

burns showed streptococcal infection more than a week after the commencement of therapy

Systemic admini
out of 56 cases
this form. A revi
pyrexia and loca
colonization
Lancefield's
0 5 gramme
Eventually
the separati
skin-loss. In only 1 out of 12 cases were streptococci isolated from 4 to 7 days after the commencement of systemic terramycin therapy. Systematic treatment with aureomycin prevented the growth of organisms in 18 of 20 cases. Apparently terramycin (50 milligrams per kilogram of body-weight daily) and aureomycin (25 milligrams per kilogram daily) were the most effective compounds employed in the investigation. These compounds, however, sometimes produced side-effects, such as nausea and vomiting, diarrhoea and colic. The authors emphasize that during each course of chemotherapy every effort was made to reduce the risks of cross-infection from the nose and from imperfectly covered burns.

Enzymatic débridement.—ALTEMEIER and his co-workers (1951) *have studied the enzymatic* débridement of burns. Investigation has so far been made of 9 different enzymes, chiefly from bacterial sources. In a study of gas gangrene it became necessary to find a collagenase for incorporation in the toxoid, and *Clostridium histolyticum* was found to be a very potent source. Original enzyme preparations were made in 3 forms: a crude liquid;

skin lysis was a prominent feature, after repeated subcultures of these organisms it was possible ... obtained from a ... been shown ... ich is papain. ... ously ... burned hours. hours 18-24 pplied own to ... e was observed in 48 hours in the second case. The authors emphasize the need for further study, to evaluate carefully any toxicity that may be associated with the digestion of the slough and the absorption of split protein products, such as polypeptides and histamine. Appar- ... comprising 2 or ... ies ... nic;

Allen, H. S (1951). *Ann. Surg*, 134, 566.
Altemeier, W. A., Coith, R., Culbertson, W., and Tytell, A. (1951). *Ann. Surg*, 134, 581.
... Krohn P. L. and Medawar, P. B. (1951) *Brit. med. J.*, 2, 1049
... ams, R D., Clatworthy, H. W., Hamwi, G., and ... *Surg*, 134, 495.
... H. (1951) *Ann Surg.*, 134, 588.
... E., and Denman, F. R (1951) *Ann Surg*, 134, 617.
Jackson, D. M., Lowbury, E. J. L., and Topley, Elizabeth (1951) *Lancet*, 2, 705.
Raker, J. W., Wight, Anne, Michel, A. J D, and Cope, O. (1951). *Ann. Surg*, 134, 614.

CHORDOMA

See also B.S.P., Vol. 3, p. 51, S Key 91.

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forwards than other vertebral chordomas, may occur at any age although they are commonest in the cancer period and are twice as frequent in males as in females. There is frequently a history of trauma. Treatment is by surgical excision followed by deep x-ray therapy Partial excision is justified to relieve pressure. The authors' case was completely relieved of his symptoms although it was not possible to remove all of the tumour. It has been estimated that the operative mortality for all cases of chordoma was 18·8 per cent and the average length of life after onset was 18 months

Crowe, G. G , and Muldoon, P B LL (1951). *Thorax*, 6, 403

COAGULANTS AND ANTICOAGULANTS

See also B.S P., Vol. 3, p 76, S Key 95

time rose above 50 seconds. On the tenth day after starting anticoagulant therapy, gross haematuria and haematemesis occurred. The prothrombin time had suddenly risen to 360 seconds In spite of blood transfusions, synthetic vitamin K, rutin and vitamin C, large bloody stools were passed for 3 days when the haemorrhage stopped. In the second case, a 57-
phleb
but,
ptysis
44-ye
cereb
turia
drop
occurred and the patient died 5 days later

Experiments with dicoumarol.—MANN, HURN and BARKER (1951) state that the prothrombin time has been accepted for some years as an index of the effect of dicoumarol, whereas the coagulation time has not been so accepted until recently It has been thought that dicoumarol in therapeutic doses affects only the reactivity of plasma to tissue thromboplastin and not to platelet thromboplastin Dicoumarol acts by causing a deficiency of co-thromboplastin which reacts with thromboplastin. Co-thromboplastin is a different entity

...the clotting times were 150 and 111 seconds respectively. When serum, platelets and plasma were mixed simultaneously, the clotting time was 57 seconds. No difference was noted between platelets from normal persons and from those receiving dicoumarol Tissue thromboplastin and a co-thromboplastin eluate were used in similar experiments The authors conclude that a larger quantity of serum or co-thromboplastin eluate is required to act on platelets than on tissue extract, and that the activity is less The coagulation process is affected similarly by dicoumarol whether it is initiated by injured tissue or by platelets

Gripe, R. P (1951) *New Engl J Med*, 245, 803
Mann, F D , Hurn, Margaret, and Barker, N W (1951) *Amer J clin Path.*, 21, 814

COLITIS

See also B S.P., Vol 3, p 88, S Key 97

Systemic administration of penicillin, 1,000,000 units daily, was limited in its effect ... out of 56 cases ... this form. A rev... pyrexia and loca... colonization by *Str.* ... Lancefield's groups (... 0·5 gramme per 100 ...
Eventually dibromopropamidine therapy was discontinued, because it appeared to hinder the separation of sloughs. Furthermore, it caused delay in the diagnosis of full-thickness skin-loss. In only 1 out of 12 cases were streptococci isolated from 4 to 7 days after the commencement of systemic terramycin therapy. Systematic treatment with aureomycin ... terramycin (50 milligrams ... ams per kilogram daily) ... These compounds, how- ... ing, diarrhoea and colic. The authors emphasize that during each course of chemotherapy every effort was made to reduce the risks of cross-infection from the nose and from imperfectly covered burns

Enzymatic débridement.—Altemeier and his co-workers (1951) have studied the enzymatic débridement of burns Investigation has so far been made of 9 different enzymes, chiefly from bacterial sources. In a study of gas gangrene it became necessary to find a ... found to be a ... rude liquid; ... hly purified ... nade *in vitro* with *Escherichia coli, Pseudomonas aeruginosa* and *Bacillus proteus* from infections in which skin lys... possible ... from a ... shown ... papain. ... nal or bullied ... 18–20 hours. ... from 3 hours to 4 days after burning, resulted in the eschar becoming mushy in consistency in 18–24 hours, so that it could be wiped away, leaving a red and viable base. This enzyme was applied to areas of complete necrosis in 2 patients; liquefaction and separation of the slough down to the viable underlying tissues took place in the first case, while no significant change was observed in 48 hours in the second case. The authors emphasize the need for further study, ... of the slough ... ar- ... or ... ies ... nic; animals may become immunized to their local digestive action.

Allen, H. S. (1951). *Ann Surg*, 134, 566.
Altemeier, W. A., Coith, R., Culbertson, W., and Tytell, A. (1951). *Ann. Surg.*, 134, 581.
Billingham, R. E., Krohn, P. L., and Medawar, P. B. (1951) *Brit. med. J.*, 2, 1049
... R. D., Clatworthy, H. W., Hamwi, G., and ... 134, 495.
... (1951). *Ann Surg*, 134, 588.
... and Denman, F. R. (1951) *Ann. Surg.*, 134, 617.
Jackson, D. M., Lowbury, E. J. L., and Topley, Elizabeth (1951) *Lancet*, 2, 705.
Raker, J. W., Wight, Anne, Michel, A. J. D., and Cope, O. (1951). *Ann. Surg.*, 134, 614.

CHORDOMA

See also B.S.P., Vol. 3, p. 51, S. Key 91.

Distribution

7 ... Murdoch (1951) report a case of thoracic chordoma in a ... pla... of ...

given a full course of penicillin therapy and then 1 drop of cortisone solution, 2·5 per cent, was instilled into the affected eyes every 2 hours from 8 a m until 10 p m. In addition 2 drops were instilled at 2 and 4 a.m The patients were asked to close their eyes and to remain at rest f
10 days
within
in 16 o
without the development of vascularization. Subsequently, however, recurrence of symptoms occurred in 2 instances. Recurrences were also encountered in 6 of 11 eyes in which vascularization had taken place prior to the application of cortisone. A second course of treatment resulted in rapid improvement. Corneal oedema was controlled and corneal infiltration was inhibited. There was no indication of drug-fastness; nor were there any side-effects. The authors conclude that the topical administration of cortisone constitutes a valuable adjunct

intramuscularly for a prolonged period of time

Bullous keratitis

Treatment by neurectomy—NOSIK and JOHNSON (1951) report on the treatment of bullous keratitis by section of the greater superficial petrosal nerve Previously, very intense pain, caused by the repeated formation and rupture of bullae, often led to the performance of

bullous formation It was believed that intracranial section of the greater superficial petrosal nerve, by curtailing the production of tears, would prevent the dilution of the precorneal film.

The central end of th
distal end was usuall
usually ambulant on
fourth or fifth day After the operation there was immediate decrease in ocular pain and in lacrimation. The corneal oedema and bullae subsided after a few days Secondary corneal stripping was sometimes necessary to obtain maximal visual acuity. Among the 6 patients in the authors' series there was no suggestion of keratitis sicca after intervals varying from 6 months to 2 years from operation All the patients had remained free from pain and there was no evidence of recurrence of lacrimation.

Crane, G W., Jun , and McPherson, S D , Jun (1951) *Amer J. Syph.*, 35, 525
Nosik, W A., and Johnson, L V. (1951). *J Neurosurg.*, 8, 498
Woods, A. C (1951). *Amer. J. Syph.*, 35, 517

DIABETES MELLITUS

See also B.S P., Vol. 3, p 250, S Key 108.

Complications

Charcot's joints in diabetic neuropathy.—LISTER and MAUDSLEY (1951) report on a case of Charcot's joints in diabetic neuropathy. Previously Bailey and Root have described 17 cases of painless destruction of the tarsus occurring in patients with poorly controlled diabetes

A group of 17 of these cases, all of the acute fulminating type of disease or of acute exacerbations of the chronic type, have been followed up for at least 3 years since operation; in this [illegible]

restore the continuity of the bowel. The operation is advocated by the authors for patients who have been given careful medical and psychiatric treatment, but who continue to lose weight and strength, or suffer from repeated colonic haemorrhages.

Gardner, C., and Miller G. G. (1951). *Arch. Surg., Chicago*, 63, 370.

CONJUNCTIVA—DISEASES AND INJURIES

See also B S.P., Vol. 3, p. 148, S. Key 101

Conjunctivitis

[illegible] of angular blepharo-conjunctivitis often show micrococci as well as diplococci Furthermore, [illegible] Differentiation of the organisms [illegible] to take the stain, whereas the [illegible] ult to isolate the diplococci on culture plates, because the colonies are obliterated by rapidly growing staphylococci *Nevertheless, isolation can be effected by adding crystal violet to the culture medium* Although staphylococci may be isolated from cases of angular blepharo-conjunctivitis the disease is not reproduced when these organisms are inoculated into human volunteers Three forms of the disease may exist, due respectively to a micrococcus, a diplobacillus and a mixed infection. Deficiency of vitamin B_6 may serve to transform the diplobacillus from a saprophyte to a pathogenic organism. As for treatment, experiments on human volunteers indicate that angular conjunctivitis due to the micrococcus is quickly cured by means of *zinc sulphate, penicillin and vitamin B_6 therapy*. Vitamin B_2 was administered to 8 patients suffering from the disease, but the treatment proved to be ineffective.

Mitsui, Y., Hinokuma, S , and Tanaka, C. (1951). *Amer. J. Ophthal*, 34, 1579.

CORNEA—DISEASES AND INJURIES

See also B.S P., Vol. 3, p 165, S Key 104

Cortisone in treatment of interstitial keratitis

Woods (1951) discusses the value of cortisone in the treatment of interstitial keratitis. Although the compound exerts a controlling influence upon the inflammatory and exudative phases of the disease it has no effect upon the causal condition *During the early stages of* [illegible] symptomatic relief. [illegible] of cortisone [illegible] 1·5 per cent. [illegible] Alternatively, [illegible] with benzal- [illegible] instilled into the conjunctival sac every hour duri[illegible] night. An ointment containing 10 milligrams of [illegible] instead of the drops. In severe cases the strength of the ointment should be increased [illegible] therapy was em- [illegible]

The treatment of interstitial keratitis by means of the local [illegible] described by Crane and McPherson (1951). Eleven patients suffering from the disease were

[illegible] courses of penicillin therapy and then 1 drop of cortisone solution 2.5 per cent [illegible]

[illegible] Recurrences were also encountered in 6 of 11 eyes in which vascu- [illegible]

[illegible] of cortisone constitutes a valuable adjunct [illegible]

the complications which may be produced when large doses of the drug are administered intramuscularly for a prolonged period of time.

Bullous keratitis

Treatment by neurectomy.—NOSIK and JOHNSON (1951) report on the treatment of bullous keratitis by section of the greater superficial petrosal nerve. Previously, very intense pain, caused by the repeated formation and rupture of bullae, often led to the performance of enucleation. The fluid within the stroma of the cornea diffuses to the endothelial or epithelial surfaces, and the electrolytes are retained, while water is lost continuously into the hypertonic fluid over the corneal surface. As the bullae rupture, the increase in epiphora leads to a lowering of tonicity in the precorneal mucous film. This leads to fluid retention and further bullous formation. It was believed that intracranial section of the greater superficial petrosal [illegible]

The central end of the nerve was elevated from its groove and a metal clip applied. The distal end was usually doubled back upon itself and clips were applied. The patients were usually ambulant on the first or second post-operative day and ready for discharge on the fourth or fifth day. After the operation there was immediate decrease in ocular pain and in lacrimation. The corneal oedema and bullae subsided after a few days. Secondary corneal [illegible]

Crane, G. W., Jun., and McPherson, S. D., Jun. (1951). *Amer. J. Syph.*, 35, 525
Nosik, W. A., and Johnson, L. V. (1951). *J. Neurosurg.*, 8, 498
Woods, A. C. (1951). *Amer. J. Syph.*, 35, 517

DIABETES MELLITUS

See also B.S.P., Vol. 3, p. 250, S. Key 108.

Complications

Charcot's joints in diabetic neuropathy.—LISTER and MAUDSLEY (1951) report on a case of Charcot's joints in diabetic neuropathy. Previously Bailey and Root have described 17 cases of painless destruction of the tarsus occurring in patients with poorly controlled diabetes mellitus. In this case the patient presented with thirst, polyuria, loss of weight, recent muscle cramps, and heaviness and loss of feeling in the lower limbs. Examination showed a peripheral neuritis. There was a discharging ulcer at the base of the second left toe. The blood sugar was 276 milligrams per 100 millilitres. Sixteen months later the patient complained of painless swelling of the right foot. Skiagrams one month later showed necrosis of the cuboid and adjacent surfaces of the navicular and lateral cuneiform bones. In addition to the previous neurological signs the position sense in the joints of the feet was grossly impaired [illegible]

blisters of the right foot developed which became infected and a below-knee amputation was carried out. The amputated limb showed extreme arterial disease. The distal end of the posterior tibial nerve showed marked endoneural and perineural fibrosis with almost complete occlusion of the lumina of some of the arterioles. The tarsal joints showed marked [illegible]

nerve, together with hyaline and fatty degeneration found in one of the intrinsic muscles of the foot examined, indicate a mixed vascular and neural lesion. The appearances in the tarsal joints are consistent with repeated trauma and lend support to the diagnosis of Charcot's arthropathy.

Neuropathic joints.—In an account of 4 cases of arthropathy due to diabetes mellitus, KNUTSSON (1951) states th[illegible]
and erosion of the joint su[illegible]
loose fragments of bone [illegible]
observed the disability in 2 men and 2 women. The ankle joint was affected in each case, and the radiological findings resembled those produced by tabes dorsalis. A considerable degree of swelling of the ankle joint was detected in the first case. Skiagrams showed extensive destruction with erosion of the joint surfaces. Subsequently the joint surfaces became smoother and there was an increase in the amount of sclerosis The Wassermann reaction of the blood was negative. Despite the presence of arthropathy, the patient was able to walk [illegible]

cent soft tissues.

Knutsson, F. (1951). *Acta radiol., Stockh.*, 36, 114
Lister, J., and Maudsley, R. H. (1951). *Lancet*, 2, 1110.

DIVERTICULA OF THE ALIMENTARY TRACT

See also B.S.P , Vol 3, p. 256, S. Key 109.

Congenital diverticula

Bleeding Meckel's diverticulum —WALTON and LILL (1952) describe 2 cases of bleeding Meckel's diverticulum occurring in young men, the presence of a diverticulum being confirmed by operation The first patient was admitted because he had passed dark brown fluid per rectum and had felt faint. A second episode of bleeding occurred shortly after admission, and yet again 4 days later. In retrospect, it was clear that a previous haemorrhage had taken place 5 years earlier whilst he was in the army. At operation a Meckel's diverti- [illegible] Gastric

[illegible] to the

distinguished from haemorrhage due to gastric or duodenal ulcers.

Walton, J. N., and Lill, Norma D. (1952) *Brit med J.*, 1, 88.

EAR—INTERNAL EAR, ACUTE INFECTION

See also B S.P., Vol 3, p. 291, S Key 113.

Treatment

[illegible]

first. The freed portion of the trunk is stitched up to the divided anterior scalene muscle to separate the divided ends as far as possible to make regeneration difficult. Smithwick ap-

Lewis, R. S (1951) *J Laryngol*, 65, 825.

EAR—INTERNAL EAR, CHRONIC INFECTION (NON-SUPPURATIVE)

See also B.S P , Vol 3, p 296, S Key 114

Operative technique

Preservation of the labyrinth —ROSEN (1951) describes a new surgical procedure for Ménière's disease which preserves the labyrinth This involves sectioning of the chorda tympani or of the chorda tympani and Jacobson's nerve-tympanic plexus The author reports on a series of 14 patients who were operated upon by the technique described Eleven of the cases have had no vertigo since operation and in one patient with Ménière's disease limited to the cochlea, the hearing has returned to a very high level and has not dropped since the operation One patient is completely free of any tinnitus and in 7 cases the tinnitus has diminished to the point of not being annoying. In no case that was operated

labyrinthotomy. The incision is made through the skin over the bony canal wall about 5–7 millimetres external to the drum. The skin being separated from the bone, the drum is then lifted out of its sulcus and reflected upward upon itself, thus exposing the tympanic cavity The author states that before sectioning the chorda, its response to electrical stimulation was observed

Rosen, S (1951) *Ann. Otol etc St Louis*, 60, 657

EAR—MALDEVELOPMENT OF

See also B.S P., Vol. 3, p 303, S Key 115.

Middle ear

Malformations and related conditions —ALTMANN (1951) describes malformations of the eustachian tube, middle ear and associated structures Variations in the anatomy of the ostium of the eustachian tube are common Diverticula develop at various sites in the tube Congenital tumours have been reported Cholesteatomas of the tympanal membrane occur but are rare, they are analogous to epidermal cysts elsewhere. Cysts of the mastoid process have been described, possibly caused by detachment of budding pneumatic cells Malformations of the auditory ossicles and their articulations are rare, the stapes is the most frequently affected and shows great diversity of malformations Severe malformations of the ossicles occur in congenital atresia of the ear Abnormal length of the styloid process may give rise to symptoms A supernumerary muscle in the facial canal is rare A persistent stapedial artery is of interest, the vessel has a fairly constant course. Normally it disappears in man during development but persists in other animals The author describes numerous malformations of the internal and external carotid arteries and their branches Frequent variations occur in the courses of the lateral and sigmoid sinuses. A forward position of the sigmoid sinus is associated with arrest of mastoid pneumatization. High position of the jugular bulb may be associated with dehiscences of the floor of the middle ear True malformations of nerves have not been reported, but the facial nerve may be hypoplastic and have an abnormal

course. Congenital facial paralysis [illegible]
of the petrous pyrami[illegible]
bony facial canal ma[illegible]
connexions between t[illegible]
very important clinica[illegible]
a sub-periosteal absces[illegible]
and in hereditary crar[illegible]
bularis and dysostosis [illegible]
have been described i[illegible]
atomas in these struc[illegible]
Their aetiology is uncertain.

Altmann, H. (1951). *Arch. Otolaryng., Chicago*, **54**, 241.

EAR—OTOSCLEROSIS

See also B.S.P., Vol. 3, p. 337, S. Key 121.

Operative technique

Some difficulties arising with fenestration operation.—McKenzie (1951) discusses some difficulties in the fenestration operation for otosclerosis. The hole which the endaural approach produces is difficult to work through. If the mastoid process is cellular, this matters little as the cavity is fairly large, but if the mastoid cells are small or absent the difficulty of approach to the external semicircular canal is real. An overhanging dura mater also makes the exposure awkward and when this occurs it is probably better to leave the bony dural plate, for the dura mater bulges downwards if it is removed, making the working cavity smaller than before. Haemorrhage may be a serious difficulty which may reduce the number of successes. The amount of haemorrhage seems to depend more on the type of [illegible]

readily. The author states that in one case the facial nerve was damaged at operation when the mastoid antrum was difficult to find. The fenestra is so important that there is a strong case for performing the operation in two stages so that the bony canal may be opened at the second stage when the risk of damage to the membranous canal is less. The author also discusses the various difficulties encountered after operation.

McKenzie, W. (1951). *J. Laryng.*, **65**, 756.

FRACTURES, DISLOCATIONS, FRACTURE-DISLOCATIONS AND ALLIED INJURIES

See also B.S.P., Vol. 4, p. 165, S. Key 157.

Fractures

Treatment.—Plewes (1951) describes modern principles in the treatment of fractures. Attention to the functional result and activity during immobilization are of the utmost importance. In the treatment of the Colles fracture much better functional results are ob- [illegible]

Plewes, L. W. (1951) *Med Pr.*, 226, 621.

GALL-BLADDER AND BILE PASSAGES

See also B.S.P., Vol. 3, p. 238, S Key 161.

Post-operative treatment and complications

Repair of injuries: recurrent stricture.—The repair of injuries to the common bile-duct is discussed by GRAY (1951). Approximately 75 per cent of the patients are under 50 years of age, and about 25 per cent are in the fourth decade of life. Recurrence of stricture in an appreciable number of cases, necessitating further operations, combined with the risk and

... The most frequent symptom of stricture of the common ... pears in about 40 per cent of cases within a few ... biliary fistula has developed, jaundice may not ... n years after the trauma has been inflicted. An ... lice when the fistula is closed and subsidence of jaundice when the fistula is draining, is characteristic, although the same symptom-complex may be caused by a calculus in the common bile-duct Gastro-intestinal and other subjective symptoms are frequent; they vary with the emotional reaction of the patient and with the secondary effect upon closely related organs Surgical treatment varies with the site and condition of the stricture; excision of the stricture and end-to-end anastomosis without tension is preferable, if a sufficient length of the duct distal to the stricture can be mobilized, but circumstances allowing this procedure are rarely seen. In the majority of cases, no appreciable remnant of the common hepatic duct may be found, and some type of anastomosis at the hilus of the liver is required. Because approximately 40 per cent of patients operated on for stricture of the common hepatic duct or common bile-duct have undergone at least one previous attempt at repair, it is pointed out that a guarded prognosis should be given in these cases

Post-operative use of split T-tube.—LAHEY (1951) describes a split T-tube and a retaining apparatus for indwelling T-tubes for the repair of strictures of the bile-duct, illustrating his comments with diagrams and x-ray plates It was found that many patients who came for surgical treatment had lost so much of their hepatic ducts, owing to previous surgical operations, that there remained only a short cuff of the common hepatic duct or of the two separated ends of the right and left ducts. The author designed a T-tube with flared upper ends, which, when introduced through a short common hepatic duct, automatically spreads

... more frequently than once in several weeks

Gray, H K. (1951) *Proc. R Soc Med.*, 44, 1005.
Lahey, F H (1951) *Surg Gynec Obstet*, 93, 173

GLAUCOMA

See also B.S P., Vol 4, p. 319, S. Key 169.

Primary glaucoma

glomerulo-nephritis. There was a history of intermittent painless haematuria, backache and recent loss of vision in the left eye. The ocular tension was found to be 18 millimetres of mercury as measured by Schiotz's tonometer. Both optic discs showed deep cupping. Blood and albumin were found in the urine, and the quantity of non-protein nitrogen in the blood amounted to 151 milligrams per 100 millilitres. X-ray examination of the abdomen and retrograde visualization of the kidneys indicated the presence of renal enlargement.

cysts. Apparently glaucoma was due to generalized ectasia of the sclera and the eyeballs

Secondary glaucoma

Glaucoma secondary to uveitis: cortisone treatment.—CRAWFORD (1951) states that the management of glaucoma secondary to uveitis is a serious problem. Both mydriatics and miotics have considerable disadvantages. He describes the treatment of such a case with cortisone. The patient, aged 64
70 millimetres of mercury, and
sion of cortisone, prepared as

condition

Berkley, W. L. (1951). *Amer. J. Ophthal.*, 34, 1539.
Crawford, H. E. (1951) *Amer. J. Ophthal.*, 34, 1320.

GONORRHOEA

See also B.S.P., Vol. 4, p. 336, S. Key 172.

Gonorrhoea in women

Antibiotic treatment.—HUNT (1951) discusses the effectiveness of modern treatment for gonorrhoea in women. A study was made, at a local gaol centre, of 100 female patients who were found at their initial examination to have a positive smear or culture or both. All were
tests of cure at
were obtained.
cillin injections,
of the aqueous or depot type, in dosages varying from 200,000 to 2,400,000 units, and, in
who had also a
idicate that
ection. The
eatment for
ice are now
2 per cent
aluminium monostearate.

Hunt, C. L. (1951) *Canad. med. Ass. J.*, 65, 351.

HAEMATOMA

See also B.S.P., Vol. 4, p. 361, S. Key 175, and *see also* Brain—Injuries and Complications, page 221.

Head injuries

Extradural haematoma.—A survey of 21 cases of extradural haematoma, treated during a
less than 1 per cent of all head injuries, is presented
atients with acute head injuries included 782 with
of the literature
sually
ential
ull is
close

to the scalp lesion, will provide the diagnosis in most cases, although the procedure may be dangerous in cases of acute cranial trauma, its most important indication is a deepening of the coma. Cerebral angiography can also be hazardous. The results of electroencephalography and diagnoses based on clinical symptoms are both of doubtful value. The ages of the patients in the present series ranged from 6 to 60 years, and the intervals between the time of injury and the operation varied from 1 hour to 30 days. Operations were performed on 14 patients, of whom 4 died; of the 7 patients not subjected to operation, all died. In 2 of the cases which did not go to operation [illegible]
cases, exploratory burr-holes made ir [illegible]
haematoma being located in the post [illegible]
meningeal artery or one of its branches in 15 cases; the origin was unrecorded in the other cases coming to operation or necropsy. The authors conclude that the main problem in these cases is not one of organization or of treatment but of diagnosis.

Brodin, H (1951). *Acta chir. scand*, 102, 99.

HAEMORRHAGE

See also B S P., Vol 4, p. 378, S Key 177.

Treatment

Upper gastro-intestinal haemorrhage —MACDONALD and YOUNGHUSBAND (1951) discuss the treatment of upper gastro-intestinal haemorrhage A considerable problem is whether [illegible]

intra-arterial transfusion With regard to feeding, the authors advocate equal parts of warm milk and cream or soft foods to a total of one ounce every 1–2 hours day and night.

Macdonald, D, and Younghusband, O Z (1951). *Canad. med Ass. J*, 65, 412

HEART AND PERICARDIUM

See also B S P Vol 4, p. 413, S Key 179.

Heart

[illegible]

patients were all in positive nitrogen balance, whereas all the male patients were *in negative* nitrogen balance The level of nitrogen balance could not be correlated with the increase in cardiac index. Patients who had undergone cholecystectomy showed greater physiological responses than did those who had been subjected to subtotal gastrectomy.

Fleming, T C, Habif, D V., and Nickerson, J L (1951). *Amer. Heart J*, 42, 334.

HERNIA

See also B S.P., Vol. 4, p. 428, S. Key 180.

Inguinal hernia

Recurrent hernia: skin-grafting at operation.—ALLEN (1951) describes the use of skin- [illegible] be bad risks from the viewpoint of recurrence. The cases were divided into four groups [illegible] years. One or both inguinal regions were skin-grafted, but not if a femoral hernia was present. [illegible] patients are notoriously non-co-operative, those with normal abdominal [illegible] and good musculature, who will control their abdominal size and take exercise, usually do [illegible] rectus sheath flap is recommended.

Allen, J. C. B (1951) *Med J Aust.*, 2, 502.

INTESTINES

See also B S P , Vol 5, p 139, S. Key 196

Tumours of the small intestine

Multiple argentaffinomas of the ileum—O'BRIEN (1951) reports a case of multiple argen- [illegible] The patient, aged [illegible] was removed. [illegible] mass in which [illegible] showed the cells arranged in [illegible] months later showed the t[illegible] of the intestine. There was spread of the neo[illegible] Three feet [illegible] later from [illegible] plastic cells [illegible] ribe a case of argentaffin tumour of the ileum with perforation. The patient, [illegible] of 40 years, had had severe intermittent abdominal pain for a year before admission to hospital. At laparotomy, following severe abdominal pain of 24 hours duration, three tumours of the ileum were present [illegible] on which was abnormally situat[illegible] perforated posteriorly. All 3 [illegible] glands [illegible] was attempted. The post-operative course was satisfactory and the patient appeared [illegible]

Congenital atresia of the small intestine

Congenital duodenal obstruction and mongolism—In a period of 25 years 32 examples of congenital duodenal atresia have been seen at Great Ormond Street Children's Hospital. Ten of these children were mongols Such an association has previously been noted by

reconsidered.

Congenital duplication of the small intestine

BARRETT (1951) discusses congenital duplication of the small intestine. These cases are

with normal bowel action, the infant died a short time later from apparently acute intestinal obstruction. The post-mortem record was unfortunately not available

Barrett, J C (1951). *Brit. med J.*, **2**, 889.
Bodian, M, White, L. L. R., Carter, C O., and Louw, J H. (1952). *Brit. med. J.*, **1**, 77.
O'Brien, J. R. (1951) *Brit. med J.*, **2**, 1315.
Stewart, I S, and Russell Thomson, G (1951) *Brit. med. J.*, **2**, 1316.

JAUNDICE

See also B S P., Vol 5, p 176, S Key 202.

Intrahepatic obstructive jaundice of unknown aetiology

GOULSTON and SMYTH (1951) report on 2 cases of intrahepatic obstructive jaundice of unknown aetiology, which apparently correspond to the so-called cholangiolitic hepatitis of Watson and Hoffbauer Case 1, a male patient aged 23 years, was admitted to hospital

Goulston, S, and Smyth, M (1951) *Med J. Aust*, **2**, 313

JOINTS—TUBERCULOSIS

See also B.S.P., Vol 5, p. 219, S. Key 207.

Operative techniques

tre
ur
an

oral doses of 10–14 grammes; during 14 days (beginning 3 days before operation) 1 gramme of streptomycin (divided into 2 doses), and penicillin (500,000 units divided into 2 doses or 300,000 units of procaine penicillin in a single dose) were given intramuscularly each day. The dose of *p*-aminosalicylic acid had frequently to be reduced or omitted in conjunction with the operation. In addition, streptomycin and penicillin were applied locally to the wound at operation, in the form of dry powder; the quantities applied were 1–3 grammes and 200,000–600,000 units, respectively, according to the size of the wound. Conteben has been used recently in occasional cases, simultaneously with *p*-aminosalicylic acid, as the basic medicament. The treatment has been administered, so far, to approximately 250 patients, and has resulted in primary healing in every instance. There have not been any

observation is required before definite evaluation of the method can be made.

Orell, S (1951) *Acta chir. scand.*, 102, 113.

KIDNEY AND URETER—CYSTS

See also B S.P., Vol. 5, p 244, S. Key 208.

Congenital cysts

(19
of

The predominating signs and symptoms comprised. (1) specific gravity of the urine persistently below 1 015; (2) bilateral uretero-pyelographic changes; (3) pain in the upper abdominal or renal regions; (4) changes in blood-urea retention and urinary excretion, (5) trace of albumin, (6) slight elevation of blood pressure; (7) bilateral palpable masses; (8) secondary anaemia, (9) haematuria. The only complications in the series were (1) infection

under the skin, and subsequent punctures are made, when required, through this scar to the

(9) pyelographic changes for the worse, (10) with the aim of prolongation of life.
the data shows that the average duration of life in polycystic renal disease is twice as long, after diagnosis is made, when the disease is treated operatively than by other methods. Surgical treatment in the 18 cases of the author's series produced relief of pain and general improvement in every instance; of 8 patients living, all but one are working and in good condition.

Acquired cysts

Multilocular cysts.—According to FRAZIER (1951) only 31 cases of multilocular cyst of the kidney have been recorded in the literature. In no instance has the disease affected both

and fatty casts. Retrograde pyelograms revealed a mass in the left flank and deformity of the left renal pelvis and calyces The phenolsulphonaphthalein test showed defective excretion on the left side An operation was performed at which a left renal tumour was removed successfully. The tumour was found to be well circumscribed, encapsulated and multilocular, with numerous cysts containing a jelly-like material On section the specimen was observed to resemble a cystadenoma Microscopical examination revealed compression of the renal tissue by the thickened fibrous capsule of the cystic mass. The cysts were lined with cuboidal and flattened epithelium Further observation of the patient showed that arterial hypertension had developed At the age of 19 years, his systolic blood pressure was 150 millimetres of mercury and the diastolic pressure was 106 millimetres. A similar tumour was removed in the case of another male child, aged 6 months This patient made an uninterrupted recovery. Frazier states that multilocular renal cysts, polycystic renal disease and

impracticable.

Frazier, T. H. (1951). *J. Urol*, 65, 351.
Goldstein, A. E. (1951). *J. Urol*, 66, 163

KIDNEY AND URETER—GROWTHS

See also B S.P., Vol. 5, p 268, S Key 210.

Clinical picture

Haemangioma.—After reviewing the aetiology, symptomatology and pathology of renal haemangioma, BUTT and PERRY (1951) report on the occurrence of such a tumour in a woman aged 60 years, who had been referred for urological consultation on account of

injected vesical mucosa and
carmine was concentrated
middle calyx of the left ki

later.

PALETZ and SEWELL (1951) report on a case of renal haemangioma in a Negro aged 21 years in whom the involvement of one kidney was proved by nephrectomy and the involvement of the other was strongly suspected He had been admitted to hospital because of profuse painless haematuria; he gave a history of attacks of
days
contai
Pyelog

ureteral orifice. The haematuria persisted at an alarming rate, necessitating repeated blood transfusions Therefore it was decided to attempt to stop it by radiotherapy; 200 r

ative dose of 435 r. The haematuria stopped 5 weeks later and the patient has been symptom-free for the past 4 years.

Thrombosis of vena cava associated with renal neoplasia.—DUFF and GRANGER (1951) draw attention to the fact that thrombosis of the inferior vena cava may be associated with renal neoplasia. At least 62 cases are recorded in the literature. Obstruction of the inferior

Laparotomy revealed thrombosis of a renal vein and of the inferior vena cava downwards. Pronounced engorgement of the collateral circulation was found in the abdominal cavity and in the deeper layers of the abdominal wall. Owing to the presence of fixation of the kidney and of extensive invasion of the inferior vena cava, it was decided not to carry out nephrectomy.

Special aids to diagnosis

Retrocaval displacement.—Retrocaval displacement and stricture of the ureter is discussed by HESLIN and MAMONAS (1951). A review of the literature reveals 40 cases, of which only 18

of veins. The anomaly is a potential cause of hydronephrosis, which does not develop invariably, but which was present in all the cases coming to operation. The symptoms

... is frequent in cases of ... parently coinci- ... ondition should

... The authors report on 4 additional cases, ... s diagnosed radiographically but did not ... was confirmed in the 3 cases coming to operation. Surgical treatment in 1 case has produced a functioning kidney, noted on examination after 8 years, the longest follow-up period in any case reported to date.

Operative technique

... itoneal nephrectomy, ... (embryonal carcino- ... been wearing a body ... after 4 months, the ... mass. Radiotherapy ... resulted in a shrinkage of about 50 per cent in the left kidney, ... ration became neces- ... of the ninth rib

hours.

Butt, A. J., and Perry, J. Q. (1951) *J. Urol.*, 65, 15.
... (1951). *J. Urol.*, 65, 368.
... *J. Urol.*, 65, 212.
...1). *J. Urol*, 65, 193.
... *Urol*, 65, 9.

LACRIMAL APPARATUS—INJURIES AND DISEASES

See also B S.P., Vol. 5, p. 325, S. Key 214.

Pathological conditions affecting the secretory system

Primary adenocarcinoma of the lacrimal gland.—IRVINE, ROBERTS and SOUDAKOFF (1951) report on 4 cases of primary adenocarcinoma of the lacrimal gland. The first patient, a

6 months later. Further treatment proved to be ineffective and the patient died several months after exenteration of the orbit Post-mortem examination revealed that irradiation had produced necrosis of a number of cylindromatous nodules. The authors state that mixed tumours recur in 20 per cent of cases. The death rate is 32 per cent Removal of the tumour may restore normal vision despite an exophthalmos of 18–20 millimetres In

frequent occurrence. Furthermore, the microscopic appearance of a Brooke tumour is of a delicate pattern, in sharp contrast to the coarse cystic architecture of a mixed tumour

Irvine, A R., Roberts, W L , and Soudakoff, P S. (1951) *Amer J Ophthal.*, 34, 1511
McKinney, W W., and Butz, W C. (1951). *Amer J. Ophthal*, 34, 1519.

LARYNX—SURGICAL DISEASES OF

See also B.S.P , Vol 5, p. 338, S Key 216

Neoplastic diseases

laryngeal function in these reported cases has been encouraging.

Emergency operations for the treatment of grave dyspnoea

RETHI (1951) describes emergency operations in laryngo-tracheal dyspnoea. The performance of the operation of tracheotomy is impeded in cases where there is danger of suffocation, if in consequence of anatomical conditions or of intense bleeding. Cancer of the thyroid may be attended by severe dyspnoea and, out of all tracheotomies, those performed for this condition represent the most difficult problems. Even simple hypertrophy of the thyroid gland may give rise to compression of the trachea particularly if the goitre is situated partly behind the sternum. The trachea is likely to be still more compressed during the operation, resulting in grave dyspnoea. In such cases where there is danger of suffocation, the author [illegible]

plished. In cases of severe compression of the lower part of the trachea due to an aneurysm or tumour, the author suggests bronchotomy in two stages, according to his method, which secures retrograde breathing and prolongs the life of the patient.

Rethi, A. (1951) *J. Laryng.*, 65, 773.
Som, M. L. (1951) *Ann. Otol. etc. St. Louis*, 60, 695.

LENS—DISEASES AND INJURIES

See also B.S.P., Vol. 5, p. 396, S. Key 218.

Cataract

[illegible] an intra- [illegible] insparent [illegible] ve power [illegible] ch a lens [illegible] late was [illegible] hickness, [illegible]

been with simple extraction alone. In one case two years after the [illegible] was no sign of inflammation of the eye

Ridley, H. (1952). *Lancet*, 1, 118.

LIVER—CIRRHOSIS

See also B.S.P., Vol. 5, p. 437, S. Key 223

[illegible] imental study of hepatic veins

[illegible] nt of hepatic venography in experiments on dogs. A [illegible] cap and a rubber balloon and armed with a straight [illegible] ious vein. With the aid of fluoroscopy the catheter is [illegible] of the leader is controlled by means of a nut. [illegible]

out the liver, even when only one hepatic vein is selected for injection. Although clinical studies have not yet been attempted, the author believes that the method could be employed as an aid to diagnosis. Anomalies in the arborizing veins may indicate the presence of pathological changes, such as tumours, abscesses and other disorders of the liver.

Porto-caval anastomosis

Chronic hepatitis with portal hypertension: effect of venous shunt.—JULIAN and DYE (1951) have used venous shunts in the treatment of portal hypertension. A series of 27 patients have been subjected to operation. 18 spleno-renal anastomoses and 3 porto-caval shunts, one through a vein transplant, have been completed. The majority of the patients had portal hypertension resulting from intrahepatic disease, the most common cause being Laennec's cirrhosis. Selection of patients for operation was made, in most instances, on the basis of gastro-oesophageal haemorrhage; varices were demonstrated in 17 cases by barium swallow or oesophagoscopy, and in other cases the diagnosis of portal hypertension was confirmed by the findings at operation. The spleen was palpable in every patient who had not previously undergone splenectomy. In 13 of the 21 cases of completed operation the patients had significant liver dysfunction pre-operatively. In 6 of the completed cases, and in 2 of those not completed, there was pre-operative ascites. The depression of liver function was severe in 5 cases, tests showing a 45-minute sulphobromophthalein retention of 35 per cent or greater In 4 of the successful operations there was unusually severe oesophageal bleeding pre-operatively; this necessitated use of the Sengstaken tube just before operation, and in 2 cases the tube was kept in place for 3 weeks pre-operatively. Complete relief of bleeding was noted in 17 cases followed up for 2–30 months Post-operative complications were common but rarely serious, they included 5 cases of pleural effusion and 2 of empyema. A distinct relief of ascites was noted in 1 case There was no significant effect from splenic-artery ligation on splenic-vein pressures in 8 cases studied The mortality in the series [illegible]

[illegible]

supply The operation has been performed on 10 patients with advanced cirrhosis of the liver, ascites and oesophageal varices, favourable results ensued, although the period since operation has been too short, and the number of cases too small, for definite conclusions to be drawn regarding the effectiveness of the procedure.

Berman, J K , Koenig, H., and Muller, L P (1951) *Arch Surg , Chicago*, 63, 379
Julian, O C , and Dye, W S (1951). *Arch. Surg , Chicago*, 63, 373
Rappaport, A. M. (1951) *Acta radiol , Stockh.*, 36, 165

LUNG—TUMOURS

See also B S P , Vol. 5, p. 450, S Key 225.

Carcinoma of the lung

Incidence—WILHELM (1951) has investigated the incidence of bronchogenic carcinoma. A study was made of instances of primary cancer of the lungs and of 6 control organs, as [illegible]

diagnosed malignant disease of the uterus, large bowel and breast has also risen progressively. In contrast with the necropsy figures, the incidence of diagnosed malignant disease of the stomach has decreased, and it has remained constant for the prostate gland (except to a small extent in the final 5 years). Malignant disease of the oesophagus has remained as constant clinically as at necropsy. It is emphasized that records of hospital admissions include readmissions for the same disease, and also that only about 33 per cent of fatal cases were submitted to necropsy; other factors to be considered include the advances in our knowledge of the pathology of bronchogenic carcinoma and in the diagnostic methods available. In the opinion of the author, the increase in the incidence of bronchogenic carcinoma is probably relative and apparent. The data in the author's series indicated a

the same patient is likely to become more frequent; in the past one or other of the diseases was usually diagnosed or

because tuberculous patie

frequently. The combina

plasia is very rare, but 1 case is mentioned. In the majority of cases one of the diseases, usually the carcinoma, is overlooked. The patients are nearly always middle-aged or elderly men. Paroxysms of severe dyspnoea, especially dyspnoea which seems unduly marked for the extent of the lesion, should suggest the presence of a carcinoma. "Meaty" sputum is also

later.

Couts, B. (1951). *Tubercle, Lond.*, 32, 223
Wilhelm, D. L. (1951) *Med J Aust*, 2, 284

LUPUS VULGARIS

See also B.S.P., Vol. 5, p 476, S. Key 226.

General treatment

Intralesional calciferol treatment.—RUSSELL (1951) gives an account of the treatment of ... injections of calciferol. Systemic treatment with calciferol ... of reasons. This series of 9 cases comprises ... lesions. Injections were given at intervals of 2 or 3 weeks and the dose on any one occasion varied from 100,000 I.U. vitamin D_2 to

might

ge of

ludes

rticu-

nt to

cular

systemic calciferol and patients with concurrent pulmonary ... disease, renal disease or in pregnancy.

Russell, B. (1951). *Arch derm syph, Chicago*, 64, 676.

MENINGES—MENINGITIS, ACUTE AND CHRONIC

See also B S.P., Vol. 6, p 69, S Key 233.

Tuberculous meningitis

Neurosurgery in diagnosis and treatment.—In this paper CAIRNS (1951) discusses neuro-

raised intracranial pressure is to persist with intrathecal injections of streptomycin; surgical methods, such as ventriculostomy and short-circuit operations, are not, on the whole, called for. Intubation of the cisterna interpeduncularis by means of fine polythene tubing, aspiration of exudate, and direct injection of streptomycin have been carried out successfully in a few cases The basal meninges have been reached by a French author through the sphenoidal fissure by transorbital approach The author describes in detail 3 cases of tuberculous meningitis with an unusual cause for the raised intracranial pressure Case 1 presented as an uncomplicated tuberculous meningitis, but shortly before death neurological signs appeared and obliteration of the left lateral ventricle was found At necropsy a large tuberculous abscess was seen in the left parietal lobe, with herniation of the uncinate gyri. Case 2 had

was discovered In Case 3 a space-occupying lesion was suspected, on the strength of angiography and of the impossibility of demonstrating the right lateral ventricle by making burr-holes. At operation, localized hydrocephalus of the inferior horn of the right ventricle was found, and it was relieved by ventriculo-cisternostomy. In these 3 cases the neurological signs developed during streptomycin treatment; the importance of re-assessing such cases is stressed.

backache, retention of urine and severe headache, and when admitted to hospital had a temperature of 105 6 degrees and the classical signs of meningitis.

The sinus over the sacrum did not appear infected, but a lumbar puncture revealed thick pus containing *Staphylococcus aureus*. He died within 12 hours.

Post-mortem examination revealed that the lower sacral laminae were not fused and that the sinus tracked right down to the spinal cord. A purulent meningitis, which was much more severe in the lumbar region, indicated that it was responsible for the *Staph. aureus* gaining entrance Histological examination showed that the sinus was very narrow until it was near the cord, when it dilated, and that except for its deeper portions it was lined with squamous epithelium

hypothesis.

Thirty-four previously reported cases of dermal sinus are reviewed but none has been

Cairns, H (1951) *Arch Dis. Childh.*, 26, 373.
Cardell, B. S , and Laurance, B (1951). *Brit med. J* , 2, 1558

MOUTH AND PHARYNX—MALIGNANT DISEASE OF

See also B.S.P., Vol. 6, p. 82, S. Key 234.

Treatment

Massive roentgen therapy in inoperable oral cancer.—WHITE and CHRISTENSEN (1951) describe the control of inoperable oral cancer by massive roentgen therapy. They state that, in their experience, the primary disease recurred or persisted in too many patients after conventional x-ray therapy. They therefore instituted in 1946 a more radical regimen con-

radical regimen and 55 patients who r
recurrence or persistence of the prima
recurrences from both groups, only 2
(radiation ulcers, osteitis) developed i
though severe, do not constitute a significant

combination of
The term "oral
ding the anterior
cluded lip 1,128
riod 1929–1945.
The ages
cases, of
have sho
value, but
the former being the more common Contributory factors include: oral sepsis, broken teeth, and ill-fitting dentures; syphilis; leucoplakia; tobacco-chewing; and foreign-body
is regarded as radiological.

or resulted in a chronic ulcer Invasion of lymph nodes

se are repaired
ctions or nerve-
section.

White, G , and Christensen, W. R. (1951) *New Engl. J. Med.*, 245, 719.
Wookey, H., Ash, C , Welsh, W. K., and Mustard, R. A. (1951). *Ann. Surg.*, 134, 529

NECK—TUBERCULOUS GLANDS

See also B S P , Vol 6, p. 186, S Key 239

Pathology and treatment of cervical or mesenteric lymphadenitis

CORBETT (1951) describes the pathology and treatment of tuberculous cervical or mesenteric lymphadenitis The bovine tubercle bacillus is responsible in 90 per cent of cases. The portal of entry is usually the tonsil in cervical adenitis, and spread of the infection is via the lymphatic vessels Spread by the blood stream is uncommon but may give rise to simul-

taneous involvement of several groups of cervical glands. Cold-abscess formation may occur and subsequently a "collar-stud" abscess, leading to sinus formation. In the abdomen the ... glands are usually involved. Here the organism passes through the wall of the

is essential, and general measures, together with the systemic administration of streptomycin,

Corbett, R S. (1951). *Med Illustr*, 5, 450

NEURALGIA—TRIGEMINAL, GLOSSOPHARYNGEAL

See also B S P, Vol. 6, p. 251, S Key 243

Treatment

dural and posterior intradural, the author prefers the lateral extradural approach as being the safest and an operation of great precision and certainty. Nerve sections peripheral to the gasserian ganglion can also be performed, and this is an excellent operation when the pain is confined to the second division. Lastly, there is trigeminal tractotomy (Sjoqvist's operation). The complications following treatment are keratitis, facial paralysis and trophic ulceration Of 500 cases treated by the author by one surgical procedure or another, without a fatality, 90 per cent were well pleased with the results.

Rowbotham, G. F. (1952). *Med Pr.*, 227, 5

NOSE, NASOPHARYNX AND ACCESSORY SINUSES

See also B S P, Vol 6, p 271, S. Key 244.

Nasopharynx

Malignant tumours—ORMEROD (1951) discusses malignant disease of the nasopharynx The neoplasms usually arise on the roof or dome of the nasopharynx or on the lateral wall in or near the fossa of Rosenmüller. The signs and symptoms may be conveniently divided into four main groups—nasopharyngeal, otological, ophthalmo-neurological and cervical metastatic The malignant neoplasms of the nasopharynx are very largely epithelial in origin. The author reports six characteristic cases of malignant disease of the nasopharynx and illustrates his comments with microphotographs and radiograms. The first, a lympho-epithelioma, remains well after 4 years The second, an anaplastic carcinoma, is well 2 years after being seen A third was characterized by the appearance of metastatic deposits in bon

before the primary tumour gave any local indication of its presence and by the presence of a large mass in the lung parenchyma. Malignant [illegible] epithelial in orig [illegible] and lymphocytc [illegible] *tumours.* Squam [illegible] tumours and a fe [illegible] Adenocarcinom [illegible] Malignant tumo [illegible] the prognosis is [illegible] radiother [illegible] or x-ray [illegible] delivered [illegible] whether [illegible]

Ormerod, F. C (1951). *J. Laryngol*, 65, 778.

OESOPHAGUS

See also B.S.P., Vol 6, p 314, S. Key 247.

Rupture of the oesophagus

Aetiology and clinical picture.—Strong, Wilson and Taylor (1951) give an account of perforation of the oesophagus and report on 7 cases of this condition. Rupture of the oesophagus has a bad prognosis unless early surgical intervention is undertaken. The first [illegible] occurs after severe retching or vomiting, usually in males who are heavy eaters and hard drinkers. Pathognomonic signs in both spontaneous and large traumatic rupture are the occurrence of interstitial emphysema in the neck and mediastinal emphysema which can often be demonstrated by x-ray examination, epigastric pain, shock, cyanosis and pneumothorax or hydropneumothorax. The second case was one of presumed foreign-body perforation in a man aged 70 years. The patient died and at necropsy 2 small rounded perforations were found at the extreme distal end of the oesophagus. The foreign body was not found. The differential diagnosis in both spontaneous and large traumatic perforation as in this case includes cardiac infarction and perforated peptic ulcer. The authors next report 5 cases of instrumental perforation of the oesophagus which occurred in a series of 600 gastroscopies. Three of these patients died, while the remaining 2 survived after mainly conservative treatment. The authors give an account of the factors involved in the causation of instrumental perforation including such factors as aortic aneurysm and dorsal kyphosis. Instrumental perforation is rarely recognized immediately. As a rule, the injury is a scoring or puncture of the oesophageal wall just below the cricoid. The first positive indication is the occurrence of interstitial emphysema. In view of the poor results from conservative treatment the authors intend that any further cases shall be treated by immediate surgical exposure of the site of the rupture, closure of the perforation, and external drainage of the adjacent infected or contaminated tissues

Treatment—Slesser (1951) discusses rupture of the oesophagus, and reports on a series of six cases This condition still carries a high mortality despite chemotherapy and antibiotics and whether the rupture be in the cervical or the thoracic oesophagus, conservative measures, the author states, appear to be unsuccessful in most cases. Healing by first intention is to be expected following prompt suture of a tear due to instrumentation of the apparently normal oesophagus. A few hours' delay, however, results in the tissues becoming oedematous, friable and ultimately sloughing. This is more frequently the case when the oesophageal tear is associated with regurgitation of gastric contents and this occurs more especially in a spontaneous rupture of the oesophagus *Some delay in suture is inevitable* and healing by first intention is less certain There arises the problem of the management of the oesophageal fistula. Some cases will close spontaneously where good drainage of the [illegible] not do so and it then becomes a matter of [illegible] a secondary suture. [illegible] and by the time the [illegible] ction, are in no state [illegible] re is relatively easy. Provided that the lung expands and walls off the infection from the general pleural cavity and that there is free drainage from the mediastinum, patients should be able to survive the

acute stage of the inflammation provided they are fed by other than the oral route. Feeding by jejunostomy is probably the best method, a Roux type of jejunostomy being recommended if it is to be maintained for some weeks.

Congenital abnormalities

Incidence.—HOLINGER, JOHNSTON and POTTS (1951) review the subject of congenital anomalies of the oesophagus because of the apparent frequency of these anomalies and because of the increasing significance as an endoscopic problem both pre-operatively and post-operatively. Complete absence of the oesophagus has not been encountered in the authors' series. It has been described as extremely rare. In these cases, the hypo-

[illegible]

ulcers. Complete atresia of the oesophagus without an associated tracheo-oesophageal defect is relatively rare. In the authors' series it was encountered 3 times Single or multiple webs are differentiated from congenital oesophageal stenosis by their x-ray and [illegible] stenosis were en- [illegible] oesophagus which [illegible] f a segment of the [illegible] shortening of the oesophagus are, first, a portion of the cardiac end of the stomach must be shown to stay above the level of the diaphragm and, secondly, the oesophagus must be shown to be too short to reach as low as the level of the diaphragm Achalasia or cardiospasm is generally considered to be a failure of co-ordination of the mechanism at the cardia which prevents [illegible]

[illegible] ital atresia of the oesophagus is discussed by SULAMAA, GRIPENBERG and AHVENAINEN (1951) This abnormality, often associated with a tracheo-oesophageal fistula, is not rare, and recent progress in treatment has made its recognition of practical importance Atresia appears in 4 [illegible]

[illegible] disease 1 case of hypospadias [illegible] comprise (1) dehydration and (2) pneumonia due to aspiration of stomach contents Tracheal fistula was present in 28 of the authors' cases. Of the 30 patients 7 survived and 23 died Treatment comprised mediastinal extrapleural ligation of the fistula and primary anastomosis of the oesophagus; in difficult cases the fistula was not separated from the trachea, but the upper segment was pulled down on to the trachea and an end-to-side anastomosis made. Local anaesthesia was obtained with 0·5–1 per cent xylocaine; morphine was used as a basal anaesthetic The mortality was high among the 3 cases regarded as [illegible] ictures, seen in [illegible] with prognosis [illegible] ne oesophagus

Simple tumours of the oesophagus

Report on a case.—It is pointed out by KORKIS (1951) that benign tumours of the oeso- [illegible]

there was no loss of weight, hoarseness or cough. Radiography showed relative dilatation about the
tumour. T
son's forc
sulphadia
radiograp
outline. C
nodular formation. These tumours
many cases are asymptomatic.
luminal and extra-mucosal or
leiomyoma, in the intra-mural group it is wise to consider surgical removal in every case.

Holinger, P. H., Johnston, K. C., and Potts, W. J. (1951). *Ann. Otol. etc. St. Louis*, 60, 707.
Korkis, F B. (1951) *J. Laryng.*, 65, 638.
Slesser, Betty V. (1951). *Thorax, Lond.*, 6, 389.
Strong, G. F., Wilson, R., and Taylor, H. E. (1951). *Canad. med. Ass. J.*, 65, 455.
Sulamaa, M., Gripenberg, L., and Ahvenainen, E. K. (1951). *Acta chir. scand*, 102, 141.

OMENTUM

See also B.S P, Vol. 6, p 354, S Key 248.

Torsion of the omentum

Torsion of great omentum. surgical treatment.—HASHEMIAN (1951) reports on 3 cases of torsion of the great omentum, occurring in men between the ages of 45 and 50 years. In Case 1 there had been aching pain in the right hypochondrium since the previous day, without nausea or vomiting. The temperature, pulse and respirations were normal. Right-sided abdominal tenderness and rigidity were present, maximal above and to the right of the umbilicus. A semi-gangrenous piece of the great omentum, 3 × 2½ inches in size, was found twisted at its base Removal was followed by uneventful recovery. No cause for the torsion
abdomen, acc
tender mass
into, but not
colicky abdominal pain for 2 weeks, then pain in the right iliac fossa. A tender mass was felt there below an appendicectomy scar. The temperature, pulse and respiration were normal.

Hashemian, H A (1951) *Brit med. J.*, 1, 276

OVARY

See also B S P, Vol. 6, p 407, S. Key 254.

Carcinoma

Review of series of 67 cases.—WHEELOCK, FENNELL and MEIGS (1951) review a series of 67 cases of carcinoma of the ovary and deal with its clinical evaluation. A report on a previous
t. The majority of
of incidence was in
of the growing mass. The tumour, unfortunately, is in a location in which
expansion can occur before the patient is aware of its presence. The authors state that the

presenting complaint of either swelling or an abdominal mass was noted in 61 per cent of the cases under review. Unfortunately the disease is often relatively advanced when the patient is first seen.

Wheelock, F. C., Fennell, R H., and Meigs, J. V. (1951). *New Engl J. Med.*, **245**, 447.

PANCREAS

See also B S P., Vol 6, p. 433, S Key 257

Pancreatic cyst

Fibrocystic disease and acute intestinal obstruction —After listing the names of some 30 earlier workers on the subject, LEVY (1951) presents a case of fibrocystic disease of the pancreas with intestinal obstruction, seen in a boy aged 7 months At the age of 9 weeks a diagnosis of fibrocystic disease had been made on the strength of absence of trypsin from the green undigested stools. Since the age of 3 weeks the infant had suffered from a troublesome cough, and x-ray films showed catarrhal change in both lungs. Several courses of penicillin were given for the pulmonary condition. With the daily administration of 60 grains of pancreatin the child progressed satisfactorily to the age of 7 months, when acute intestinal obstruction developed Laparotomy, under the diagnosis of intussusception, revealed nothing abnormal except (1) a plum-coloured small intestine, distended by putty-like material, (2) haemorrhages at the root of the mesentery, and (3) an empty colon. The child died on the day after the operation. The necropsy confirmed the diagnosis of fibrocystic disease and the absence of any organic obstruction. A Table, showing the 55 cases of fibrocystic disease of the pancreas associated with intestinal obstruction published in the literature, is presented and discussed The oldest case on record is of an infant 4 days old, and therefore the obstruction, if not due to an organic cause, could be ascribed to meconium ileus The case presented by Levy is outstanding, in that no other cause for the obstruction was found than the abnormal physical state of the intestinal contents revealed at the comparatively advanced age of 7 months. In that case the figures for total and split fat had been normal, because the patient had been given the pancreatin for the last 4 months of life.

Levy, E (1951) *Arch. Dis. Childh*, **26**, 335.

PARALYSIS—MANAGEMENT OF

See also B S P, Vol 6, p 445, S. Key 258

Physical restoration

plegia and are of several different kinds The illness is often progressive. With regard to technique it is probably best to remove the postero-superior quadrant of the cerebral hemi-

there was marked emotional disturbance prior to operation was a marked feature of the general improvement There was also a startling improvement in intellectual performance In each case there was an improvement in the grossly abnormal patterns shown on the electroencephalogram but there were slight persisting abnormalities at the time of the last observation Temporary general motor weakness of all limbs may be seen after operation. Immediately after operation in the three cases the contralateral limbs became flaccid but spasticity returned within 2 weeks although not to the pre-operative level There was no change in the sensibility of the affected or the unaffected limbs following operation Only 1 patient had demonstrable visual function in the affected hemisphere before operation which resulted in the conversion of a slight partial homonymous hemianopia into a complete one. In the 2 patients with right hemisphere disease no change in speech was observed after operation. In the third case, in which meningitis developed after operation, there was some temporary mutism. The authors conclude by discussing important questions of cerebral function that are raised by the study of the hemi-decorticate individual.

Cairns, H, and Davidson, M. A. (1951). *Lancet*, **2**, 411

there was no loss of weight, hoarseness or cough. Radiography showed relative dilatation about the junction of the pharynx. Endoscopy revealed a pedunculated simple submucosal tumour. The tumour and its pedicle were removed by avulsion of the pedicle with a Paterson's forceps. Post-operative treatment, with parenteral penicillin and orally administered sulphadiazine, resulted in uneventful recovery. A repeat barium swallow was carried out; [illegible]

nodular formation. These tumc [illegible] many cases are asymptomatic. [illegible] luminal and extra-mucosal or [illegible] leiomyoma, in the intra-mural group it is wise to consider surgical removal in every case.

Holinger, P. H., Johnston, K. C., and Potts, W. J. (1951). *Ann. Otol. etc. St. Louis*, 60, 707.

Korkis, F. B. (1951). *J. Laryng.*, 65, 638

Slesser, Betty V. (1951) *Thorax, Lond.*, 6, 389.

Strong, G. F., Wilson, R., and Taylor, H. E. (1951). *Canad med. Ass. J.*, 65, 455.

Sulamaa, M., Gripenberg, L., and Ahvenainen, E. K. (1951). *Acta chir. scand.*, 102, 141.

OMENTUM

See also B S.P , Vol. 6, p. 354, S Key 248.

Torsion of the omentum

[illegible]

abdomen, accentuated in the right iliac fossa. The hernia, which was reducible, contained a tender mass. Torsion of the entire great omentum was found at operation, with a projection into, but not adherent to, the hernial sac. Excision resulted in recovery. Case 3 suffered [illegible]

Hasheman, H A (1951) *Brit. med J*, 1, 276.

OVARY

See also B.S.P., Vol. 6, p 407, S. Key 254.

Carcinoma

[illegible] ich considerable [illegible] rs state that the [illegible]

presenting complaint of either swelling or an abdominal mass was noted in 61 per cent of the cases under review Unfortunately the disease is often relatively advanced when the patient is first seen.

Wheelock, F. C., Fennell, R. H., and Meigs, J. V (1951). *New. Engl J. Med.*, **245**, 447.

PANCREAS

See also B S.P., Vol 6, p. 433, S Key 257.

Pancreatic cyst

Fibrocystic disease and acute intestinal obstruction —After listing the names of some 30 earlier workers on the subject, LEVY (1951) presents a case of fibrocystic disease of the pancreas

ture, is presented and discussed. The oldest case on record is of an infant 4 days old, and therefore the obstruction, if not due to an organic cause, could be ascribed to meconium ileus. The case presented by Levy is outstanding, in that no other cause for the obstruction was found than the abnormal physical state of the intestinal contents revealed at the comparatively advanced age of 7 months. In that case the figures for total and split fat had been normal, because the patient had been given the pancreatin for the last 4 months of life.

Levy, E. (1951) *Arch Dis. Childh.*, **26**, 335

PARALYSIS—MANAGEMENT OF

See also B S P , Vol. 6, p 445, S. Key 258.

Physical restoration

Infantile hemiplegia treated by hemispherectomy.—CAIRNS and DAVIDSON (1951) discuss the treatment of infantile hemiplegia by hemispherectomy and report on 3 cases treated in this way. Treatment is usually s
affects the arm more than th
ventricle is usually dilated
plegia and are of several di

no worse in the third case The improvement in the emotional state in the 2 cases in which there was marked emotional disturbance prior to operation was a marked feature of the general improvement. There was also a startling improvement in intellectual performance In each case there was an improvement in the grossly abnormal patterns shown on the electro-

the conversion of a slight partial homonymous hemianopia into a complete one. In the 2 patients with right hemisphere disease no change in speech was observed after operation. In the third case, in which meningitis developed after operation, there was some temporary mutism. The authors conclude by discussing important questions of cerebral function that are raised by the study of the hemi-decorticate individual

Cairns, H , and Davidson, M A. (1951). *Lancet*, **2**, 411.

PARATHYROID GLAND—DISEASES

See also B S P., Vol. 6, p. 467, S. Key 259.

renal function was poor. Lung skiagrams were reported as showing some generalized fibrosis

skeletal decalcification due to hyperparathyroidism. The serum calcium level was high, inorganic phosphorus low, and serum alkaline phosphatases raised with normal plasma

was removed at operation.

Salmon, H. W. and Meynell, G.G (1951). *Brit. med J.*, 2, 1440.

PELVIC ORGANS—DISPLACEMENT

See also B S P., Vol 6, p. 478, S Key 261.

Genital prolapse

Stress incontinence in women: mechanism and treatment.—Basing his opinion upon studies of the anatomy of the mesenchymal wall of the embryonic urethra, HUFFMAN (1951) attributes the mechanism of stress incontinence to a weakening of the supporting periurethral attach

laxity

portio

incontinent patients the urethra is under stress and drops away from the symphysis. ... more, downward or outward dislocation produces distortion of the neck of the bladder and of the proximal part of the urethra. In the normal female the external urethral meatus is pulled upwards and forwards during the voluntary inhibition of urination. Weakness or failure of this mechanism may occur in patients with stress incontinence. Hence perineal

Stress incontinence of urine: with special reference to failure of cure ... operative procedure—For stress incontinence, READ (1950) describes Millin's sling operation, which he performed in 126 cases, with 91 complete cures, 21 improvements, 13 failures and 1 death It is indicated in the absence of utero-vaginal prolapse after attempts at cure *via* the vaginal route have failed The vesical neck is first defined by means of a Malecot or Foley catheter Using Trendelenburg's position and employing careful haemostasis throughout, a generous transverse incision, slightly convex downwards, is made at the level of the anterior superior spine down to the aponeurosis The flaps are undermined, the anterior ... is separated from underlying muscle Two ... 1 centimetre wide, and are ... The recti are then separated ... ssed from within outwards ... are drawn through the recti. ... rom the pubis, the bladder- ... digitally on either side, but ... umb and forefinger, special ... ptum and the straps passed ... the straps are sutured where ... the junctions of the middle ... rough and sutured together

of the sphincter mechanism is almost always due to trauma Damage to the supporting tissues may result from obstetrical injury or from post-operative scarring. In nulliparous women the basic defect is poor development of the sphincter fibres Incontinence may not occur

and his colleagues. The patient is placed during examination so that the neck of the bladder

fistulae, and intrinsic and extrinsic lesions of the bladder. It is important to note, however, that infection must be eradicated before these operations are performed

Huffman, J W (1951). *Urol cutan Rev*, 55, 583.
Pagano, A. F, and Leen, W B (1951) *Urol cutan, Rev*, 55, 612
Read, C. D (1950). *Amer. J Obstet. Gynec*, 59, 1260

PEPTIC ULCER AND ITS COMPLICATIONS

See also B S.P, Vol 6, p 496, S Key 262

Surgical anatomy

Necropsy findings, innocent and malignant. —BOUDREAU, HARVEY and ROBBINS (1951) have made an anatomical study of benign and malignant gastric ulcerations The investigation was carried out on the findings at 234 out of a total of 8,493 necropsies, performed during a period of 10 years Only lesions forming discrete excavated craters were included Cases of

in which measurements were made) from 1 centimetre or less to 4 centimetres or more in

to cause confusion with benign ulcers in the same areas. Haemorrhage and perforation with peritonitis were the first and third most frequent causes of death in non-malignant gastric ulcerations; as differential points, haemorrhage and perforation were more common in benign than in malignant lesions In the author's opinion, the results of their study indicate that gastric ulcers in patients over 50 years of age cannot be assumed to be malignant and they demonstrate the fallibility of depending on any clinical feature in differential diagnosis

Treatment

Medical and surgical treatment in general practice —The treatment of peptic ulcer in

are later superimposed on the basal hourly feeds, on return to work, the patient may have a more liberal diet, avoiding unsuitable foods; a mineral antacid may be alternated with the hourly feeds of milk and cream (3) Reduction of gastric acidity by one of 2 groups of antacid (a) mineral antacids, gastric mucin, protein hydrolysates and anion-exchange resins, which neutralize acid; or (b) parasympathetic blocking-agents and certain hormonal

preparations, which inhibit the production of acid The prevention of recurrence is best

of

der

regarded as malignant until shown to be otherwise by complete and maintained healing, as demonstrated by radiography, cessation of symptoms, and disappearance of occult blood from the stools.

been disappointing, except in some cases of gastro-jejunal ulcer.

Gastric resection for duodenal ulcer.—Ross and WARREN (1951) discuss the safeguards in gastric resection for duodenal ulcer. In a series of hospital admissions, 35 per cent of the

ts, con-

of the

depend upon pathological proof that the antrum and pylorus have been removed.

authors there are four essentials for an adequate partial gastric resection. (1) There is the

well above

the greater

ssel leading

the pyloric

l procedure

is not, however, essential, if both the antrum and the pylorus of the stomach completely removed and the duodenal closure is secure.

Results of treatment

peptic ulcer during a 10-year period,

personal conversations, haemoglobin determinations and erythrocyte counts. The *operative*

following operation,

s gastro-

symptoms occurred ...

by 8 men and 2 women. Anaemia was found in 26 6 per cent of the male patients and in

sweating and palpitation; the symptoms occur most commonly after operations with a gastro-jejunal anastomosis. The vomiting of food which has passed into the afferent jejunal loop, mixed with bile—the "afferent-loop reflux"—is most frequent after left-to-right gastro-jejunal anastomoses A gastro-intestinal stoma which is too small may cause distension and slow emptying of the gastric stump, and may need to be enlarged (2) Symptoms of hypoglycaemia may appear in the late postprandial syndrome, 2–3 hours after a meal, rapid emptying of the stomach causes glucose to be absorbed from the jejunum more quickly than usual, the resultant hyperglycaemia may stimulate overproduction of insulin, with a subsequent fall of blood sugar. (3) The deficiency syndromes include (a) loss of

duced by the introduction of a homogenized standard meal through a jejunostomy stoma

; the "dumping"

characteristic of

-T segment, and

the P-wave was high. An impairment in the function of voluntary muscle was demonstrated on electromyography—a finding which indicated a reduction in the amount of available serum-potassium. Although the intravenous injection of a potassium compound failed to prevent symptoms due to "dumping", this treatment brought about a premature termination of the attack. The author attributes the lack of potassium to the release into the blood of a humoral agent resembling adrenaline. The phenomenon may also be produced by an unduly

-storing cells.

its with peptic ulcer, treated by extensive gastrectomy between 1940 and 1947. Of 90 patients followed up for 9–90

37 gas

combı

found; a fourth patient died 5 years later from carcinoma. No case of macroscopically

pain and 6 patients had severe pain, but none of these 8 cases showed any abnormality on x-ray examination of the stomach; 60 patients had no nausea, 76 had no vomiting, 68 were free of flatulence and 58 had no distension. Early post-prandial syndrome was present in

14 cases, late syndrome in 13 and both in 3. The early syndrome was less common after the partial end-to-side than after the end-to-side anastomosis In 58 out of 85 cases of all types of ulcer, achlorhydria was achieved. Only 4 cases of microcytic anaemia were discovered and none of macrocytic anaemia. The results were better in males than in females. Subjectively, 66 patients expressed great satisfaction with the result of the operation; 14 said that they were much better, and 7 no better.

Results of vagotomy alone or combined with other operations.—WALTERS and BELDING (1951) report on the clinical and physiological effects of vagotomy, both alone and in combination with other operations, in 130 unselected cases. The follow-up period was 1–4 years. In the immediate post-operative period, free hydrochloric acid was reduced in 93·5 per cent

per cent of cases in which vagotomy was the only procedure, but in only 3·6 per cent of cases in which gastric-drainage operations were also carried out. The Hollander insulin test was carried out on these patients, and the authors state that, whereas it appears in an over-all group of cases to be a good prognostic test, it is of little value in the most important group of cases—those of recurrence. The results of treatment were classified as "excellent", "unsatisfactory", and "poor", the authors giving their own criteria for classification. Vagotomy alone was performed on 25 patients with duodenal ulcer. Results were excellent in 64 per

results in 5 cases and proved recurrent ulcera-

gastro-jejunal ulceration following gastro-enterostomy,

7 cases, with excellent results in 5 cases, unsatisfactory

1 case. In 5 cases the gastro-jejunal ulcer was excised,

special conditions, for the treatment of gastro-jejunal ulceration after gastro-enterostomy. They consider that there is little place for vagotomy alone in the treatment of duodenal ulcer, and that vagotomy should not be performed for gastric ulceration.

Comparison between vagotomy and resection—A comparative evaluation of the relative effectiveness of vagotomy and gastric resection has been made by HEALY, HELLMAN and

the remaining patients being personally interviewed, and almost half the number investigated during short periods in hospital. The case-fatality after vagotomy was 2·4 per cent and after gastric resection 3·2 per cent. Early post-operative complications were of similar frequency in relation to both operations but were more serious after gastric resection: the frequency of undesirable late complications, on the other hand, was much higher in the vagotomy group. The final evaluation of cases of non-obstructing duodenal ulcer showed 87 per cent of the patients to have improved and 13 per cent of cases to be regarded as failures after gastric resection, as against 65·9 per cent improvements and 34·1 per cent

of the entire gastric resection group (including obstruct-

per cent of cases

(1951) present an evaluation of 5 years' experience of vagotomy in the treatment of chronic peptic ulcer.

16 patients had had perforations closed by operation, 4 had had previous gastro-enteros-

gastric ulcer, vagotomy is regarded by the authors as suitable only for patients in poor condition, with lesions high in the fundus or cardia which have been proved benign by biopsy It is recommended especially for stomach ulcers following gastro-enterostomy or

which has sometimes consisted in extramural myotomy of the distal part, oesophago-

be an improvement on this in that it does not invite peptic erosion He inquires whether

out that the oesophagus becomes of more normal size than after any other method used hitherto

Achalasia· cardiospasm —BREAKEY, DOTTER and STEINBERG (1951) discuss the pulmonary complications of cardiospasm, presenting a series of 64 case-reports illustrated by x-ray plates. Respiratory symptoms are commonly associated with cardiospasm. A fair percentage

of patients with cardiospasm have nocturnal cough and dyspnoea, but the direct causal relation between cardiospasm and its manifold pulmonary complications is not well recognized. The authors give Tables *summarizing the pulmonary* complications encountered, [illegible]

[illegible]

lobar *involvement is known to have been present, the right upper lobe* was involved 12 times, the right lower lobe 8 times, the right middle lobe 5 times and the left upper lobe 3 times.

[illegible]

gastro-enterostomy, or closure of another perforation. It was found that a fairly large number [illegible] free from symptoms, although they had not followed [illegible]

[illegible] expected. The author recommends the teaching and practising of simple closure of perfor*ated duodenal ulcers until a better method of treatment can be demonstrated.*

Radical operations for the prevention of future ulceration

[illegible] *—It is pointed out by* [illegible]

for studying experime... [illegible] the experiments, and when the isolated total pouch was prepared by transection at the cardia and pylorus, with the oesophagus and duodenum united and the vagi divided, a meagre [illegible] noted. In over 50 animals thus treated no spontaneous ulcera- [illegible] t when the antrum was removed from [illegible] denum, a marked increase in secretion [illegible] ulceration in several cases, occurring in a case after 11 days. In some *animals* [illegible]

jejunostomy had been performed became ill, 8 out of 10 [illegible] If intestinal continuity were restored by anastomosis of the stomach with the first part of the duodenum, after a transplant of the antrum into the colon, the animals kept well. Only 2 out of 10 dogs subjected to gastro-duodenostomy developed small ulcers. *It is pointed out* that the electrolytic balance remains normal and the general condition good after antrum-to-

Bancroft, F. W. (1951) J Amer. med. Ass., 147, 364.
Bingham, J. (1951). Canad. med Ass. J., 65, 312.
Boudreau, R. P., Harvey, J. P , Jun., and Robbins, S. L (1951). J. Amer. med. Ass., 147, 374.
Breakey, A. S., Dotter, C. T., and Steinberg, I (1951) New Engl J. Med., 245, 441.
Drablos, A., Linden, V., and Skjelbred, P. (1951). Acta med scand., 140, 327.
Dragstedt, L. R , Oberhelman, H. A., and Smith, C. A. (1951). Ann. Surg., 134, 332
Healy, M. J , Jun , Hellman, S. J , and Sauer, P. K. (1951) J. Amer. med. Ass , 147, 368.
Miller, F. M., Knight, A., and Olson, J. H. (1951) Arch Surg., Chicago, 63, 303.
475.
199.

PLEURA—DISEASES OF

See also B S P , Vol 7, p 55, S. Key 270.

Actinomycosis, new growths

Pleural cysts: development and diagnosis.—LIPPERT, POTOZKY and FURMAN (1951) believe that pleuro-pericardial or pleuro-coelomic cysts are more common than is generally suspected, and suggest that they develop from a single cause. The pericardium arises from a series of separate lacunae, which later fuse to form the pericardial coelom; this, at first independent, later communicates with the pleuro-peritoneal coelom. The communication is

many such cysts which have not caused any symptoms

Lippert, K. M., Potozky, H , and Furman, I. K. (1951). *Arch intern. Med*, 88, 378

POLYCYSTIC DISEASE

See also B S P , Vol 7, p 103, S. Key 275.

Aetiology

has atrophied One ureter may open into the prostatic urethra or into the vagina. In the

female, an accessory ureter may open into the vestibule and ...
appearance ...
Pyelograms ...
injection of indigo-carmine or methylene blue ...
at a disadvantage, because of ...
cortical ischaemia. The concent...
is damaged by obstruction or ...
than normal to maintain adeq...
required may be more than the ...
the normal acid-base regulating mechanism, so that the alkali reserve drops very easily in tubular damage. Because of inability to eliminate ammonia and to conserve chloride in emergency, there is considerable danger of alkalosis even without tubular damage. Dehydration may produce permanent tubular damage. Discussing the nature and treatment of ...

be averted if the cysto-ureteric shutter mechanism is incompetent. In nephrocalcinosis large doses of citrates should be given to build up the base reserve In recurrent infection of an apparently normal urinary tract ...
author ...
hydratic...
no special problems

Nash, D. F. E. (1951). *Ann R. Coll. Surg. Engl*, 8, 193.

PROSTATE

See also B S.P., Vol. 7, p. 133, S. Key 278.

Inflammation

found in the excised specimens in every instance. ...
pulmonary lesions in most cases, only 1 case—a ...
disease—showed any evidence of active tubercul...
vasa deferentia and seminal vesicles, as well as routine examination of the urine, also gave negative results Pre-operative studies of blood chemistry and renal-function tests yielded normal results in all cases. The haemograms were not abnormal. The ages of the patients ranged from 44 to 79 years, 4 being under 50 years of age. The duration of symptoms in 6 cases was less than 6 months Irritability of the bladder was present in most cases, and operation was performed for the relief of symptoms. Only 2 patients had a marked amount of residual urine, one of these patients was admitted in acute retention and the other case exhibited the paradoxical incontinence of an overflow bladder. The findings on rectal ...

scopy were not suggestive of a tuberculous infection The amounts of tissue removed at operation, recorded in 10 cases, varied from 2 to 150 grammes In 7 of the cases, glandular hyperplasia was found associated with the tuberculosis, the dominant associated lesion in the other 4 cases being non-specific prostatitis with contracture of the vesical neck. Convalescence was uneventful in every instance, and the results were comparable with those of operation in benign enlargement of the prostate gland.

Benign hypertrophy

Incontinence operative relief of total incontinence.—STRONG and VAN BUSKIRK (1951) have evolved an operation for the cure of total urinary incontinence in the male. The method utilizes the principles of abdominal fascial aponeurotic sling and reconstruction of the urogenital diaphragm. A case is recorded in which the operation was performed on a patient aged 52 years, who was totally incontinent of urine as a result of transurethral resection, in

which both the internal and external sphincters had been divided. The patient was unable to

expulsive force was good The operation resulted in progressive improvement in control, until the patient was able to retain as much as 725 millilitres of urine, and to void with good control except for the loss of an occasional few drops of urine on sudden coughing Re-

Operative technique of prostatectomy

Methods of prostatectomy: perineal, suprapubic, transurethral and retropubic—Discussing prostatic surgery, ROLNICK and ROBBINS (1951) state that modern treatment has resulted in a considerable reduction in mortality and morbidity. Thus haemorrhage can now be controlled by means of the resectoscope, and infection is no longer regarded as a serious problem. The mortality from prostatic surgery should not be greater than 4 per cent In most instances death is avoidable unless it is due to a cardiovascular accident. The choice of operation depends upon the circumstances of the case A stout man with a large prostate gland requires a perineal operation For a large prostate gland associated with haemorrhage, removal is best effected through the suprapubic route. If a small contracture is present the transurethral route should be employed Transurethral resection was performed in 150 cases of obstruction of the neck of the bladder due to benign prostatic growths, and 131 of these cases were observed for a period ranging from 3 to 14 months. Beneficial results were recorded in 81 per cent of cases. It was noted that better functional results were obtained in cases with the larger forms of hypertrophied prostate than with relatively small glands Secondary resection was needed in 20 cases Transient incontinence occurred in 2 instances —a complication which can be avoided by cutting distally to the verumontanum. Stricture of the meatus requires repeated dilatation, but stricture of the urethra may be induced by overdilatation. In order to avoid the latter complication it is advisable to employ Nesbit's method of inserting a resectoscope through an external urethrotomy After transurethral resection, contracture of the neck of the bladder may be produced by thermal penetration of the current. In some cases frequency and dysuria may occur even when no contracture is present These symptoms may be due to sclerosis of the prostatic bed resulting from thermal penetration. Good functional results were obtained in 23 out of 24 cases after retropubic prostatectomy The resectoscope was used in the treatment of 2 patients with delayed haemorrhage. Symptoms persisted in a patient with a contracture which resulted from poor technique, but improvement ensued after transurethral resection. So far as technique is concerned, it is stated that the functional results of retropubic prostatectomy are likely to be improved by ensuring that the pelvis is elevated adequately, and by employing a transverse abdominal incision.

Retropubic prostatectomy with preservation of prostatic urethra—SCHWARTZ (1951) describes a modified form of retropubic prostatectomy, in which the prostatic portion of the urethra is preserved Lateral and small median adenomas are removed by employing an extra-urethral and extravesical technique After exposure of the prostatic capsule a sound (size 24) is passed into the bladder. Sutures are placed distally and proximally in the venous plexus of Santorini, and a transverse incision is made in the prostatic capsule The incision

the catheter is withdrawn within 3 days Schwartz has performed the operation in 20 cases, with uniformly successful results. Complications did not occur and in no instance did any patient remain in hospital for a period longer than 8 days.

...

after internal urethrotomy for relief of chronic filiform stricture of the anterior urethra.

...

prostate gland, during many months or even years, has assumed the duties of the external sphincter mechanism, with resultant chronic relaxation, muscle weakness and eventual atrophy of the sphincter in varying degrees. He states that he has observed a direct relationship between the size of the gland and the duration of the incontinence, and also between the general debility of the patient and the duration of the incontinence. Prevention does not ... weeks, ... view to ... Rolnick

Results of treatment

End-results of transurethral resection.—Ultimate results after transurethral prostatic ...

...

nocturia (0–2 times), freely and easily performed urination with good control. (2) Good: the patient was satisfied, but nocturia was 3–4 times; some patients complained of strain or hesitation, although urinary control was normal. (3) Poor: the patient was dissatisfied and noc ... relapses were reported. Of ... ced in the first 2 groups. The ... currence. There was no ...

...

performed in 6 cases because of persisting obstruction; 4 of these patients failed to benefit from repeated treatment. The author emphasizes that a good result from transurethral prostatic resection depends upon the removal of all hypertrophic tissue down to the "false" ... the tissue from the outer limits of resection and ...

... "punch" prostatectomy ... on the long-term ... ed up 461 out of 657 patients under their care for symptoms due to prostatic enlargement. Per-urethral ... done in 400, being 97 per cent of those requiring operation, and all have ... subsequently ... its were well ... ere operated ... ht averaging ... by the inci- ...

Baker, W. J., and Graf, L. C. (1951) *J. Urol.*, 66, [illegible].
Chapman, T. L., and Sutherland, J. W. (1952) *Brit. med. J.*, 1, 72.
Davis, E. (1951) *J. Urol.*, 65, 93.
... (1951). *J. Urol*, 65, 408.
... 102, 135.
... 951) *J. Urol*, 66, 234.

PULMONARY TUBERCULOSIS

See also B.S.P., Vol 7, p. 197, S. Key 281.

Lung resection

Standard dissection operations in children.—Ross (1951) describes a series of cases of pulmonary resection for tuberculosis in children. The pneumonectomies were performed for extensive unilateral disease, except in one case where there was evidence of contralateral ... Of the lobectomies, these were performed where other methods were ineffective in

... ency procedure.
... possible in the
... ndicated, blood
... If the disease

There were no deaths in the author's series of cases. One patient has had reactivation of a contralateral lesion. The other patients are alive and well.

Thoracoplasty

Late results.—A late follow-up of patients treated by thoracoplasty is presented by RYDER, MULLEN and STEPHENS (1951) A review has been made of 83 cases, treated during a period

...

quently, 3 died from causes not related to tuberculosis Of the 7 patients classed as unimproved, 2 are at present in a sanatorium; the others are unfit for work or are only able to do

...

intercurrent respiratory disease.

REFSUM (1951) gives a comprehensive report on the role of thoracoplasty in cavernous pulmonary tuberculosis. A detailed comparison is made with control cases which had been treated conservatively. The control material used by the author consisted in 106 patients treated at a single sanatorium between 1921 and 1928 These cases were carefully selected in retrospect, by the study of their x-ray plates and the clinical findings. The cases all fulfilled

...

who could not be traced The mortality in the control cases was 37 per cent after 3 years, 63 per cent after 6 years, and 77 per cent after 12 years from the beginning of the survey. The operative technique carried out by the author in this investigation consisted predominately in apicolysis-thoracoplasty under local anaesthesia. The results of thoracoplasty in 584 cases are analysed, those in 391 cases in which a unilateral thoracoplasty was carried out being analysed in detail. A further 170 cases are used only for data concerning the post-operative mortality. In addition, 15 patients were submitted to re-operation after initial operation elsewhere. Only 8 patients had a bilateral thoracoplasty. The 391 patients subjected to unilateral thoracoplasty were followed up for from 6 to 15 years. The main differences between the control material and the surgically treated material at the beginning of the observation period were that only 10 per cent of the control group had pulmonary infiltration

of more than two-thirds of the lung, as against 23 per cent in the surgically treated group. The opposite lung was normal in 47 per cent of cases in both ... trations were p ...

carr ...
per c ...
after ...
note ...
the c ...
standing. It increased after phrenic denervation on the operated side. The most frequent causes of death were (1) spread of the disease in the lung, (2) retention of bronchial secretions, and (3) nonspecific pneumonia. The author states that all patients are regarded as ...

The more extensive the operation, the less was the amount of cavity-closure produced; after thoracoplasty 73 per cent of cavities smaller than 2·5 centimetres in diameter were obliterated, as were 66 per cent of cavities between 2·5 and 4 4 centimetres and 48 per cent with a diameter of more than 4 4 centimetres Cavities situated laterally in the lung showed ...

contralateral pneumothorax, in 14 cases there was no post-operative death. Reactivation of the disease occurred in 20 per cent of the number of patients who became symptom-free, about 50 per cent of this number died. The reactivation usually appeared on the non- ...

Refsum, E. (1951). *Acta tuberc scand*, 25, Suppl No. 29, p. 11.
Ross, C. A. (1951). *Thorax*, 6, 375.
Ryder, J , Mullen, L. M , and Stephens, H. H (1951). *Canad. med. Ass J*, 65, 362.

PYLORIC STENOSIS OF INFANTS

See also B S.P., Vol. 7, p. 246, S. Key 283.

Aetiology and pathology

Theory of post-natal development —McKeown, MacMahon and Record (1951) believe that, in cases of infantile pyloric stenosis, the tumours develop after birth. An investigation ...

stillborn infants, but relatively few cases have been recorded. On examining the case-notes of 578 patients suffering from infantile pyloric stenosis, the authors found that only 33 patients were submitted to operation before the age of 3 weeks and that in 8 of these cases no tumour was present. Relatively few large tumours were observed in infants aged less than 5 weeks. After the age of 3 weeks, the proportion of large tumours increased regularly. After the tenth week, four-fifths of the tumours were large. The size of the tumour was closely correlated with the age of the patient. It is possible, however, that although hypertrophy was postnatal some change may have occurred in the pylorus at birth. The mean durations

McKeown, T., MacMahon, B., and Record, R. G. (1951) *Lancet*, **2**, 556.

RECTUM—BENIGN TUMOURS OF

See also B.S.P , Vol. 7, p. 319, S Key 289.

Epithelial tumours

as they appear.

Mayo, C. W., DeWeerd, J H., and Jackman, R J. (1951) *Surg Gynec. Obstet.*, **93**, 87.

RECTUM—CARCINOMA OF

See also B S P., Vol. 7, p 325, S Key 290.

Operative treatment

Excision combined with colostomy: post-operative obstruction of the small intestine.—

was due to adhesions, 1 case in which the ob... culum, and 1 case of strangulated hernia thr... comprise... loop of s... thereby... gap had... become... the deve... causing ... comprised 10 cases of obstructions originating in the vicinity of the colostomy. In 5 cases this was due to adhesions to the peritoneal aspect of the colostomy wound or to the edge of the mesocolon: 3 of these occurred among ... colostomy. In 1 c... wound. In the sec... peritoneal leaves of the iliac mesocolon. In the remaining 3 cases herniation was through the peritoneal isthmus on the outer side of the colostomy. The author... and diagnosis of the obstruction. A clear ... mechanical obstruction and paralytic ileus. ... preventive measures are stated to be of importance in minimizing the risk of post-operative obstruction (1) The suture which is used for the pelvic peritoneum should bring serous surfaces into apposition, and should turn the free edges ... cavity. (2) The lo... lateral space shou... left iliac region. In... men.

Goligher, J. C., Lloyd-Davies, O. V., and Robertson, C. T. (1951). *Brit. J. Surg.*, 38, 467.
Hughes, E. S. R. (1951). *Med. J. Aust.*, 2, 499.

RETINA

See also B.S.P., Vol. 7, p. 407, S. Key 296.

Simple detachment of the retina

Diathermy and antibiotics in treatment.—FORBES (1951) gives an account of a man, aged ...

multiple holes in the periphery. Diathermic surgery was employed and the retina was attached successfully. Dihydrostreptomycin was prescribed during the post-operative period. Three months after the operation there was a sudden detachment of the upper part of the left retina. On this occasion aureomycin was prescribed by mouth in a dosage of 250 milligrams 5 times daily. Spontaneous attachment of the retina took place 2 weeks later. Subsequently central vision was found to have improved and the patient was able to resume his work in a newspaper office.

Forbes, S. B. (1951). *Amer. J. Ophthal.*, 34, 1597.

SPINAL COLUMN

See also B.S.P., Vol. 7, p. 539, S. Key 306

Injuries of the spine

Mechanism of cervical radicular lesions.—FRYKHOLM (1951) has investigated the mechanism of cervical radicular lesions resulting from friction or forceful traction. Following cervical laminectomy (performed on 8 adult cadavers) the head of the cadaver was moved in different directions by an assistant, while observations were made of the intraspinal structures. Records were made of visible movements of the dural sac, spinal cord, nerve roots and radicular nerves. The influence of various movements of the shoulder and arm were also observed and recorded. The brachial plexuses in 2 cadavers were exposed sufficiently to allow of manual traction to each of the trunks, and a study of the influence of forceful traction on the intraspinal structures was then made. These experiments were carried out on 1 additional cadaver after removal of the cervical spine and both plexuses. The various connexions between the nerve trunks and the bone were separated step by step.

The study revealed that
e and an adjacent
argins of the dural
it not usually with
from traction in-
ulder-girdle in any

roofing" the intervertebral foramen by means of dental burrs—"hemilaminectomy"—has been evolved. It gives adequate exposure of the radicular nerve, restoring the horizontal diameter of a constricted foramen and making unnecessary the removal of hard intra-foraminal disc protrusions Root-sheath fibrosis requires unsheathing of the nerve roots to ensure full decompression.

arterial blood pressure. None of the controls developed any pressure whatsoever. The author postulates that under certain conditions the disc may acquire an abnormally high internal pressure and that the sudden attack of hypertension inside the disc may then constitute an attack of acute lumbago The appearance of an external protrusion impinging on a nerve root will convert the picture from one of lumbago to one of sciatica

Fractures

from his injuries. Re-examination shows that 1 patient has persistent pain and slight limitation of movement without reduction of working capacity, and 1 patient continues to have mild backache after heavy work.

Intervertebral disc lesions

Indications for operation on protruded discs, and results of operation.—O'CONNELL (1950) reviews the indications for and the results of the excision of lumbar intervertebral disc protrusions in 500 cases Surgical intervention should be reserved for those cases in which

conservative measures fail. [illegible] ment of severe neurological [illegible] large protrusion; this was [illegible] indications were relative. Operation was usually avoided when symptoms were of less than 3 *months' duration.* [illegible] other series were un[illegible] *To the author there* [illegible] series the operation [illegible] stretching forces. Twenty-five per cent of the patients were followed up for 4 or more years after operation, 50 per cent for 3 or more years, and 75 per cent for 2 or more years There were symptoms referable to the disc lesion in 53·5 per cent of cases [illegible] ever, only 8 cases showed persistent cr[illegible] lumbar pain either severe or persistent. [illegible] point of view. Out of 4[illegible] [illegible] reduced or absent in over 80 per cent of cases. With regard to neurological signs, out of a total of 378 cases 57 showed persistent motor disturbance, 114 showed persistent sensory disturbance and 234 cases showed persistent reflex disturbance. The operative mortality in this series was 0 4 per cent. In 10 cases re-operation was required for recurrent lesions in 7 cases at the same site.

Electromyograms in cases of post-operative pain due to stretch injury.—MACK (1951) reports on electromyographic studies of the sacrospinalis muscles in 18 patients who complained of low-back pain during the post-operative period following removal of a protruded intervertebral disc. Of the 18 cases 6 showed reduction or absence of motor-unit action potentials and the presence of marked fibrillations. These findings were recorded up to 5 centimetres lateral to the operation wound and 5–6 centimetres in a longitudinal direction. All the patients had been subjected to unilateral laminectomy. Normal electromyographic recordings were present on the non-operated side. In the 6 cases showing denervation there were complaints of diffuse low-back pain of moderate severity. The onset of the pain was 15–30 days after operation. In the remaining 12 cases, active motor-unit action potentials were observed, and in all these cases no pain was present at the time of study. The average duration of post-operative denervation was 183 days In all cases improvement or cessation of pain paralleled the improvement in the electromyographic recordings. Of the patients who presented a normal electromyogram, 3 had had some back pain for 60 days post-operatively: one for 95 days, one for 120 days and one for 148 days Other workers have con[illegible] sacral nerves transmit cutaneous fibres supplying the lower back and buttock. If a stretch injury has occurred, pain or hypersensitivity in these areas is to be expected. The pain may also result from ligamentous strain, caused by loss of protective muscular power as a result of sacrospinalis denervation.

Charnley, J. (1952). *Lancet*, 1, 124.
Frykholm, R (1951). *Acta chir. scand*, 102, 93, 158.
Mack, E. W. (1951) *J Neurosurg*, 8, 469
O'Connell, J. E. A. (1950) *Ann. R Coll Surg Engl*, 6, 403.
Olsson, O (1951). *Acta chir scand.*, 102, 87

SPINAL CORD

See also B S P., Vol 7, p. 572, S. Key 307.

Compression paraplegia

Rare causes, and treatment by laminectomy—TENG, GROSS and NEWMAN (1951) report on 4 cases of spinal-cord compression caused respectively by osteitis deformans, giant-cell tumour (2 cases) and polyostotic fibrous dysplasia. These are all rare causes of spinal-cord compression. Case 1, a man aged 65 years, presented with difficulty in walking and numbness of both lower limbs of 15 months' duration Myelography showed a complete block at the level of the third thoracic vertebra After laminectomy there was considerable improvement.

Microscopy of the removed bone showed the changes of osteitis deformans. The authors have found 37 cases of osteitis deformans with spinal-cord compression reported in the literature since 1923. In that series only 3 of the patients were females. In 31 cases the compression of the cord was at the level of the thoracic vertebrae. No treatment other than

operative radiotherapy. Case 4 (the case of polyostotic fibrous dysplasia), a woman aged 37 years, presented with weakness and numbness in both legs and severe pain in the posterior mid-thoracic region At the first operation, a laminectomy of the thoracic vertebrae 5, 6 and 7 was performed, and an extradural tumour was removed from the spinal canal. After the operation the patient became symptom-free, but 15 months after her discharge paraplegia suddenly developed. Exploration of the spinal canal from Th 4 to Th 7 was carried out, and an extradural tumour removed. The patient made a slowly progressive recovery. Microscopy of the removed bone showed the changes of polyostotic fibrous dysplasia. The authors state that they have been unable to find any previous report of spinal-cord compression due to this disease.

Tumours

Lumbar and sacral cysts.—Schreiber and Haddad (1951) report on 4 cases of lumbar and sacral cysts causing pain. These cysts are fluid-filled swellings, either occurring within the nerve or arising from the dura as meningoceles Case 1, a man aged 42 years, presented with severe back and leg pain. At operation the fifth lumbar lamina was found to be abnor-

had an operation for a lesion of a lumbar intervertebral disc 6 weeks previously. The main presenting symptom was difficulty in micturition. At operation there was a cyst, 3 centimetres in diameter, in the second sacral nerve After incision and irrigation of the cyst the bladder function promptly returned The authors suggest that local nerve trauma may lead to an intraneural haemorrhage and this in turn to the formation of an intraneural cyst Case 4, a man aged 30 years, had previously had an operation for prolapsed intervertebral disc, during the course of which the sheath of the right sacral nerve had been torn and some cerebrospinal fluid had escaped The patient presented with right-hip pain At operation there was a cyst, 2·5 centimetres in diameter, beneath the upper edge of the sacrum at the junction of the dura and the exit of the first sacral nerve The cyst was removed. Section showed the walls to be characteristic of a meningocele The authors state that this occurs as a result of an unclosed dural defect at a previous operation Such a defect should be sutured or if this is not possible, the arachnoid membrane should be incised.

Other operations on the cord

Surgical treatment of pain.—Erasmus (1951) discusses some aspects of the surgical treatment of pain If the removal of a stump-neuroma once fails to bring relief, subsequent removals are almost always useless. Even section of the nerve is then rarely of benefit

there was relief of pain during the short period of survival. Section of the lateral spino-

causes some disappointment, probably because of the bilateral conduction of spino-thalamic sensation. Mesencephalic tractotomy gave relief of pain in the shoulder and neck, and in the

side of the face, in 2 cases. The relief was accompanied by homonymous hemianopia, which was no disability.

Erasmus, J. F. P. (1951). *S. Afr. med. J.*, 25, 711.
Schreiber, F., and Haddad, B. (1951). *J. Neurosurg.*, 8, 504.
Teng, P., Gross, S. W., and Newman, C. M. (1951). *J. Neurosurg.*, 8, 482.

SPLEEN—SURGERY OF

See also B.S.P., Vol. 8, p. 1, S. Key 308

Splenic anaemia

[illegible] main types of disease providing indications for this treatment are (1) those with intra-hepatic block and (2) those with extra-hepatic block, as seen in Banti's syndrome. Portal cirrhosis may not always be associated with varices in the alimentary tract, for the disease [illegible]

Porta-caval, spleno-renal and other venous shunts.—BLAKEMORE and FITZPATRICK (1951) point out that portal hypertension, or Banti's syndrome with portal hypertension, has a grave prognosis if cirrhosis of the liver and haematemesis are recorded. These author's describe the saving of life in such cases, if a porta-caval shunt is performed. In a series of 148 cases, in which the portal-pressure readings were repeatedly checked, very good results were obtained and gastro-intestinal haemorrhage was checked, whether the portal or the splenic vein was chosen for the shunt. In cases of bleeding into the intestines after splenec-[illegible]

a special t[illegible] cases.

Kala-azar [illegible]

Effects o[illegible]*, and* [illegible] *histological changes in* [illegible] (1951). At first the spleen i[illegible] contain large numbers capsule and [illegible] When the disease of [illegible]

a positive aldehyde reaction. Hypersplenism sometimes persists after the primary disease has been cured Splenectomy may be of value in treating drug-resistant kala-azar.

Blakemore, A. H , and Fitzpatrick, H. F. (1951) *Ann. Surg.*, **134**, 420
Linton, R. L. (1951). *Ann. Surg.*, **134**, 433
Sen Gupta, P. C , and Bhattacharyya, B. (1951) *J. Indian med. Ass* , **21**, 1.

STERILIZATION OF SURGICAL APPARATUS

See also B S.P., Vol. 8, p 39, S. Key 311

Methods of sterilization

Bactericides· benzchlorophenol—BEAN and BERRY (1951) give an account of the bactericidal activity of benzchlorophenol in aqueous solutions of potassium laurate. A strain of *Bacterium coli* was used for the weaker solutions and a strain of *Pseudomonas pyocyanea* for the stronger solutions. A standardized inoculum was added to a standard volume of the bactericide, and samples of the mixture were incubated in sterile tubes at 20° C. The reaction was quenched as desired by adding sterile nutrient broth The tubes were then incubated for 3 days at 37° C , and at the end of this time were examined for sterility. Preliminary experiments showed that the concentrations of potassium laurate used in these experiments had an almost negligible bactericidal activity on their own account. This also applied to aqueous solutions of benzchlorophenol. In experiments designed to show the effect of

As the potassium laurate concentration increased beyond 0 02–0 04 M, the bactericidal activity decreased, but beyond a concentration of 0 04 M there was a further small increase in activity. Further experiments, in which the concentration of benzchlorophenol was increased in constant concentrations of potassium laurate, showed that this produced a

and potassium laurate were kept constant, the degree of saturation of the micelles decreased The relation between the percentage saturation of the micelles and the activity of the solu-

the number of benzchlorophenol-containing micelles adsorbed on each bacterium

Bean, H. S , and Berry H. (1951) *J Pharm* , 3, 639.

STOMACH—DISEASES OF

See also B.S.P , Vol 8, p. 88, S Key 313.

Gastritis

Gastric obstruction resulting from the swallowing of corrosive poison.—PAUL (1951) reports 3 cases of gastric obstruction as a result of swallowing a corrosive poison. Many cases of pyloric obstruction as a result of swallowing a corrosive in which no lesion of the mouth,

of the pyloric canal. A posterior gastro-enterostomy was performed and the patient made an uninterrupted recovery. The second patient presented with vomiting, extreme emaciation and dehydration 16 days after swallowing 2 ounces of concentrated nitric acid. Laparotomy showed uniform thickening of the pyloric canal. A posterior gastro-enterostomy was performed and the patient made an uninterrupted recovery. The third patient presented with copious vomiting more than one month after swallowing 4 ounces of acetic acid. X-ray

Paul, M. (1951) *Lancet*, 2, 1064.

STRABISMUS AND HETEROPHORIA

See also B.S.P., Vol. 8, p. 49, S. Key 312.

Esophoria

of esophoria has been al axes to converge) is al abnormalities of the of esophoria in which thoptics, and base-out netres. Only 1 patient

response to forced abductio 10 sclera at the equator of the ent cases. After the operation 13 ism esotropia (convergent squin vas dioptres at 20 feet and 16 l The near point of convergence was not altered. The author concludes is a safe and effective procedure.

Stine, G. T (1951) *Amer. J. Ophthal*, 34, 1307.

TESTICLE AND TUNICA VAGINALIS

See also B S P., Vol. 8, p. 174, S. Key 320

steroids.—The histological s been studied by ASHBELL, a series of interstitial and tumours of mice, a group human seminomas. Sections, 10-20 er cent formalin for periods varying some sections d for rtho- dal in bonyl nature, other sections bonyl groups. Procedures, each groups in the lipoid of formalin-fixed tissues, were repeated in representative

Cholesteatoma of epididymis.—PINGREE and BROWN (1951) report on a case of choles-

and was found to involve only the caput of the epididymis Microscopically the caput was composed of dense connective tissue, throughout which scattered ovoid areas of densely

Tumours of spermatic cord primary or secondary.—To some 260 cases of primary or secondary tumours of the spermatic cord already reported, BROCKOW and GUMMES (1951) add 2 further cases, one primary and one secondary Case 1 was a man aged 69 years, who complained of a painless swelling in the right inguinal region, of 15 months' duration A firm fusiform mass, slightly tender and slightly mobile, was present in the position of the spermatic cord, extending from the region of the external ring to the epididymis. Orchidectomy, with removal of the cord as far as the external ring, was performed Microscopically the tumour was found to be a mesothelioma, composed of sheets and strands of small

Ashbell, Rivka, Cohen, R. B , and Seligman, A. M. (1951). *Endocrinology*, 49, 265.
Boden, G , and Gibb, R. (1951) *Lancet*, 2, 1195.
Brockow, J L , and Gummes, G. (1951) *J Urol.*, 65, 136
Pingree, L. J , and Brown, D. E. (1951) *J. Urol* 65, 126.

THORACIC AND INTRATHORACIC INJURIES

See also B.S.P., Vol. 8, p. 203, S. Key 323.

Anatomy

mortem material, using a new technique. The bronchial arteries were outlined by a contrast medium injected into the aorta under pressures equal to the mean systolic pressure recorded during life. Radiographs were taken as soon as the injection medium was thought to have *cooled and hardened sufficiently to prevent leakage from small vessels during the manipu*lations of the specimen. Antero-posterior views and lateral views with the hilum facing either the tube or the plate were used. The injection medium consisted of a solution of an equal amount of bismuth oxychloride cream and 50 per cent of gelatine in water. It flowed evenly at temperatures between 25° and 35° C. At no time did penetration into the capillary bed obscure the vascular relationships. The authors found that all bronchial arteries appeared to originate from the aorta but no constancy as to their number or their level of origin was discovered. The authors' technique revealed a constant radiological pattern in all of the 10 cases under observation. This permitted the nomenclature of the bronchial tree to be adapted to the bronchial arterial divisions outlined radiographically. In addition, a well-marked annulus surrounding the main bronchi near the hilum and a constant apical pleural branch were recognized.

Treatment of thoracic injuries

RIDER (1951) reports the case of a man

seventh ribs fractured. Once the soft tissues and ribs had been removed a large hole 12 centimetres in diameter was left in the chest wall. Since skin flaps were not considered sufficient to cover this defect, a piece of tantalum mesh 18 centimetres square was sutured to the

se in bron-
retion was
ken simul-
ach patient
was much
76·3 milli-
ms per 100
ubic centi-
4·0 micro-
n of iodide by the bronchial
that the expectorant action of

of atelectasis.

Radiology

was left in the septum; the electrocardiograms gradually returned to normal and the patient went back to duty. A wounded soldier, aged 18 years, had a very loud friction rub, audible over the entire praecordium, it was heard most loudly near the sternum in the second and third intercostal spaces Angiocardiography showed the presence of a foreign body in the right ventricular cavity After the patient had convalesced, during which time he had a pericardial effusion, the foreign body was removed from the cavity of the ventricle; one end was found to be penetrating into the interventricular septum. In angiocardiography the pictures should be taken at intervals of 1–1½ seconds.

THROMBOSIS AND EMBOLISM

See also B S P , Vol. 8, p 234, S Key 324.

Functions of clotting and thrombosis

Emotions in relation to clotting time and viscosity of blood.—SCHNEIDER (1951) reports an experimental study of life situations and emotions in relation to the clotting time and relative viscosity of the blood The series consisted of 6 patients with a history of more than one attack of thrombophlebitis who had not requested help because of emotional problems. Generally the following procedure was adopted An initial specimen of blood was taken and the next 15–20 minutes was spent in discussing neutral non-stressful topics. A second specimen was then taken, after which a stressful period of interview was conducted over approximately 30 minutes following which the third sample of blood was taken. The final 20 minutes were spent in a discussion aimed at rendering reassurance and reducing anxiety. A final specimen of blood was then taken The reaction to the stressful interview was a striking shortening of the clotting time and a moderate increase in blood viscosity. One patient with polycythaemia vera was in marked contrast to the other patients in that the

viscosity when a pressor response occurred Patients with recurrent thrombophlebitis appear to have adapted a defence response which prevents blood loss, but the response is of such intensity and so prolonged that it has become dangerous.

Thrombosis of renal vein in an infant

PARRY (1951) presents a case of unilateral renal-vein thrombosis in an infant aged 1 month which was diagnosed before operation on the strength of the following history and findings: (1) asphyxia after birth, (2) slight discharge from the cord stump, (3) haematuria, (4) pyrexia,

(5) vomiting and dehydration, and (6) a large, smooth, tender, left-sided, renal swelling.

and stagnation, may also be a predisposing factor. Anticoagulant treatment may be of prophylactic value in preserving the remaining kidney.

Insidious thrombosis of the abdominal aorta

ab
Al
to 15 years Diagnosis
comprise: (1) inability

was 80, and regular There was presystolic triple rhythm at the apex and a soft systolic murmur. The blood pressure was 210/110 in both arms, and 140/80 in the thighs by oscillometry. The femoral, popliteal and ankle pulses were impalpable. There was muscle wasting in the lower limbs, and the feet were cold and pale Small circular haemorrhages were seen in the fundi, and the right disc was oedematous A slight trace of albumin was found in the urine Conservative treatment giving no relief, thoraco-lumbar sympathectomy was performed. The aorta was found to be pulseless, and to be completely occluded by thrombus from immediately below the origin of the renal arteries to beyond its bifurcation. Renal

hips and
hen first
and it is
agnostic

Thrombophlebitis

dia
fer
4) as
usly.
nbo-

Control of oedema should
by lumbar ganglion-
prompt treatment in
d.

Treatment

Aortic embolectomy.—Madden (1951) discusses the technique for aortic embolectomy, and describes a technique which was evolved through the process of trial and error. It is

the patient is placed in the Trendelenburg position The basic principles which are believed to underlie the surgical removal of an arterial embolus comprise: (1) an early operation, preferably within the first 8 hours, (2) an adequate surgical exposure, (3) the production of the minimum of trauma, particularly to the intima, and (4) the interruption of the circulation for a minimal period after the thrombus is removed. In the technique described by the author, mechanical devices or tape ligatures for haemostasis are not used Instead, for this

the incised margins of the intima, and facilitates a meticulous insertion of the everting mattress sutures of fine silk

Boyd, A. M. (1951). *Proc R Soc. Med.*, 44, 506.
Goodwin, J. F, and Petrie, E (1951) *Brit. Heart J*, 13, 554
Madden, J. L (1951) *Surg Gynec. Obstet*, 93, 167
Parry, E W (1951) *Arch Dis Childh*, 26, 358
Schneider, R. A (1951) *Amer J med Sci*, 222, 562

THYROID GLAND—DISEASES OF

See also B S.P, Vol 8, p 256, S Key 327.

Lateral aberrant cancer

OLSEN (1951) has made a survey of lateral aberrant thyroid cancer This term refers to

remnants of the lateral *Anlage* have never been demonstrated, whereas accessory thyroid glands, originating from the thyro-glossal duct, are not uncommon. The lateral thyroid tumours are highly differentiated, and are usually termed papillary adenomas or cyst-

thyroid gland, the lateral tumours were almost stationary during 20 years, and distant metastasis did not occur.

Posterior mediastinal goitre

on the right side. The author describes 3 such cases, in 2 of which a goitre was removed

the point of origin be the posterior aspect of the lobes, however, the goitre might descend into the posterior mediastinum. Thyrotoxicosis is stated to be the prime indication for surgical removal, but even the prospect of further increase in size of the goitre at so vital an anatomical site suggests removal in some cases. The author suggests that examples of posterior mediastinal goitre may not be so rare as the relatively few cases reported in the literature would suggest.

Thyroiditis

untoward occurrence With tissue fixed in Zenker's fluid, it is in under 5 per cent of cases that no pathological diagnosis can be made, representative sections usually being obtained. *From their study of these specimens the authors conclude that subacute thyroiditis,* Riedel's struma and struma lymphomatosa (Hashimoto's disease) are, in fact, separate entities;

because of its adherence to other soft tissues in the neck; the histology is one of intense

Diagnosis

Radioactive iodine.—In the opinion of SEED, JAFFÉ and BAUMEISTER (1951), no matter

jects with this

urinary-excretic

bound iodine. T

being given, and it is pc ... matter of iodine

rather than of research. ... the iodine uptake

is increased and average ... 95 per cent in the

majority of cases. T ... goitres and 29 per cent

in the large group ... lowest when uptake is

highest, being betw ... per cent in normal sub-

uptake in acute thyroiditis may

an over-acting gland.

Treatment

... types of thyro-

... fication and

... ral manage-

as an index of the amount concentrated in the metastases. The relative concentration of radio-iodine by metastatic deposits was determined by counting with the Geiger-Muller tube at skin contact. In all patients total thyroidectomy either surgically or with radioactive iodine preceded the administration of thiouracil which was given in doses of from 1 0 gramme to 1 5 grammes per day. Tracer doses of radio-iodine were given at approxi-

deficient iodine uptake of the diseased tissue, to such an extent that inadequate irradiation

who had secondary deposits showed an even greater avidity for iodine after prolonged

acil was given to increase still further the uptake of the isotope by the neoplastic tissues. Where radioactive iodine was taken up in a few instances by rapidly growing anaplastic carcinomas, the uptake was not sufficient to be of any therapeutic value. Some lesions classified as papillary had a follicular component and took up appreciable amounts of

radioactive iodine. Radioactive iodine therapy was beneficial in 10 out of 50 patients who had total thyroidectomy ... had follicular adenocarci... one had papillary aden... rehabilitation of only a very few was possible after treatment. The rate of growth of some

... in a single dose were given, no other blood changes were observed. Ovarian destruction and localized inflammatory reaction in the bladder occurred in patients with secondary deposits in the pelvis, probably due to the proximity of the lesion containing the isotope. Liver function tests have indicated liver damage in one patient as a result of treatment with the isotope.

... use of radio- ... its. After the ... thyroid and

... for patients who are poor surgical risks, the administration of large doses of radioactive iodine may one day replace radical surgery. Radio-autographs are pictures produced on photographic films by exposure to microscopic sections of thyroid glands from patients who were given radioactive iodine before thyroidectomy. Their use makes it possible to ... of the gland, and they are especi- ... s, although ... iation, are

... eatment ... author to be most effective against follicular adenocarcinoma of the thyroid gland.

Operative technique

Adequate and inadequate operations —Bartlett (1951) points out that, although the fashion ... after thyroidectomy per- ... lobes were ... refore advo- ... ed on all of

... rtheless, the ... as recurrent laryngeal nerve palsy is more common and the results are in no way superior.

... treatment of thyrotoxicosis

... the entire ... The body-weights ... nd daily; ... nay have ... ue. Fifty

administered to 34 patients, who were examined

atrophy.

Radioactive iodine tracer studies after thyroidectomy.—SZILAGYI (1951) and his co-

the possibility that iodine utilization by the small

between thyroidectomized and myxoedematous cases are quantitative rather than qual[illegible]

Bartlett, W. (1951) *J. clin Endocrinol.*, **11**, 1179.
Crile, G , Jun , and Hazard, J B (1951). *J. clin. Endocrinol* , **11**, 1123.
Dobyns, B. M (1951) *Surg. Gynec Obstet.*, **93**, 415.
Dobyns, B. M , and Maloof, F. (1951). *J clin Endocrinol.*, **11**, 1323.
Goode, J. V , Grollman, A., and Reid, A. F. (1951). *Ann. Surg.*, **134**, 541.
Olsen, A. (1951) *Acta chir scand.*, **102**, 128.
Rall, J. E., Miller, W. N , Foster, C. G., Peacock, W C., Rawson, R. [illegible]
J. clin. Endocrinol., **11**, 1273.
Rawson, R. W., Rall, J E , and Peacock, W. (1951). *J. clin Endocrinol.*, **11**, [illegible]
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Seed, L., Jaffé, Bertha, and Baumeister, C. (1951) *J clin. Endocrinol.*, **11**, [illegible]
Szilagyi, D E., McClure, R D , Connell, T. H , Jun , Watson, J. H, [illegible]
L. E. (1951). *Ann Surg* , **134**, 546
Wilson, E. (1951) *Brit J Surg* , **39**, 120.

TROPICAL DISEASE—SURGERY IN

See also B S P., Vol 8, p. 299, S. Key 329.

Ulcers

of a light plaster cast, as much bed rest as ... by injection, and skin grafting between th... The penicillin dosage varied, but probably ... and again for 2 days at the time of grafting is the optimum. Pain and foetor are rapidl eliminated. Since spontaneous healing of these ulcers is slow, skin grafting is essentia Thiersch grafts are advocated and the wound inspected 6 or 8 days later. If the firs dressing appears good, then healing can confidently be expected. Some of these grafts wer done by relatively untrained African staff, with good results. Although it appears unlikel that the patients can return to work in under 14 days, if the ulcer is 90 per cent covere ... were suc ... between ... onomy i ...

fied) with leg ulcers, 3–4 centimetres across and 4 weeks old, were given 3 per cent aureo mycin hydrochloride ointment locally. Smears were sterile in 3–5 days, and the ulcers heale in 12–14 days. Aureomycin may provide growth factor for devitalized tissue. Pus, experi mentally subcutaneously inoculated over the external malleolus, produced a spreadin tropical ulcer. It was concluded that ointment avoids oral toxicity. Despite slower steriliza tion and daily dressings, the ulcer heals quicker.

Ampofo, O., and Findlay, G. M. (1951). *Trans R. Soc. trop. Med. Hyg.*, 45, 265.
Obrien, H. D. (1951). *Brit. med. J.*, 2, 1544.

URAEMIA

See also B.S.P., Vol 8, p. 361, S. Key 334.

Treatment

A new type of c ... is presented by Lc ... first type provides ...

chambers. The blood is pumped through a common ... and rises through the blood chambers, flowing over the permeable membrane and leaving at the top through a common header; the electrolyte solution enters through a common ... ne on the side ... nmon header ... hich each cell consists of a chamber in which is mounted a circular or rectangular sheet of Cellophane; ... w blood to flow on ... ood enters the first ... through the re- ...

... er and over again ... tively remove low molecular nitrogenous products from the aqueous solutions. In the ...rs' experience, the dialyser appears, from a limited use with human beings, to be an efficient substitute for the kidney for *various lengths of time.*

Lowsley, O. S., and Kirwin, T. J. (1951). *J. Urol.*, 65, 163.

URETER—TRANSPLANTATION OF

See also B S P., Vol. 8, p. 370, S Key 335

Operative technique

RUSCHE (1951) describes the preparation for and the operative technique and post-operative management of uretero-intestinal anastomosis. For 5 days before operation the patient receives Sulphathaladine (phthalylsulphathiazole), Sulfasuxidine or aureomycin 5 times a day; a saline cathartic, a daily enema, vitamin B complex and a low-residue high-protein diet. A large de Pezzer catheter or a soft colonic tube is inserted in the rectum on the operation morning and kept *in situ* for 5–7 days. Rusche used the Nesbitt method in his last 37 cases The proximal end of the divided ureter and all coats of the sigmoid colon are incised for 1 centimetre. The ureter and intestine are joined by a continuous single layer of 00000 chromic catgut, all the coats being penetrated In order to fix the bowel and place the

convalescence. Because the electrolyte balance of the blood is disturbed, many patients

Rusche, C. (1951). *J. Urol.*, 65, 550.

URINARY ANTISEPTICS

See also B.S.P., Vol. 8, p 418, S Key 338.

Bacterial sensitivity in urinary infections

In the opinion of GIERTZ and GULLBRING (1951), an essential to the effective use of chemotherapeutic and antibiotic substances is a knowledge of the degree of sensitivity possessed by the causative micro-organisms for the drugs which may be used. The authors have made a comparison between clinical results and bacterial-sensitivity tests in the treatment of urinary-tract infections by chemotherapy An investigation was made in about 200 cases of urinary-tract infection; the drugs studied comprised (1) sulphanilamide derivatives, (2) penicillin and (3) streptomycin. The most frequently used of the sulphanilamide derivatives was Elkosin (Ciba), given in doses of 1 gramme or 0·5 gramme 5 times daily; other preparations in other dosages were used in a few cases. Penicillin was administered in most instances

disappeared from the urine during chemotherapy; of 180 strains indicated by sensitivity tests as resistant, only 8 responded to chemotherapy. A discrepancy is thus shown in 5 per cent of the clinical material. In tests of an intermediate group, chemotherapy gave positive clinical results in some cases but was ineffective in others.

Giertz, G., and Gullbring, B. (1951) *Acta chir scand.*, 102, 121

UTERUS—FIBROIDS

See also B S P., Vol. 8, p 427, S. Key 339

Operative treatment

the pubo-cervical fascia as its forward extension. Therefore, shortening of the pubo-cervical

[illegible]

prolapse, a tuck in the pubo-cervical fascia just below the cut vaginal edge will be sufficient. [illegible]

Macleod, D. (1951). *J. Obstet. Gynaec. Brit Emp.*, 58, 583.

UTERUS—CARCINOMA OF THE BODY

See also B.S.P., Vol 8, p. 440, S. Key 340

Special aids to diagnosis

Cytological diagnosis —SEIBELS (1951) advocates the use of cytological studies in the diagnosis of cancer of the uterus. The author reports on a series of cases in which 2,229 cytological tests were m [illegible] the uterus. Only 1 [illegible] 4 patients had sligh [illegible] signs of disease. When Seibels compared his findings with those of other investigators, it was noted that a total of 3,700 cytological tests had been effected and that the laboratory tests indicated the presence of uterine cancer in 45 cases; 20 of these patients were symptom- [illegible] has been smeared on a slide, it is fixed in a solution of isopropyl alcohol and ether. A few drops of glycerine are placed on the smeared material, and a clean glass slide is pressed on to this area. The preparation is then sent to the laboratory for processing.

[illegible] marked fibrosis and black discoloration [illegible] er, there were [illegible] tive gold was also found in the lymphatic glands. Some blood vessels were occluded by endarteritis Some of the patients had inactive colloidal gold injected on one side, and this behaved similarly to active gold on the other The amount of gold found in the lymphatic glands was [illegible]

Prognosis

[illegible] of the body of the uterus [illegible] squamous tumours. According to Broders' grading, the majority were [illegible]

Seibels, R. E (1951). *Urol cutan. Rev*, 55, 611.
Sherman, A. I, Bonebrake, MacD, and Allen, W. M. (1951) *Amer. J Roentgenol.*, 66, 624.
Way, S. (1951). *J. Obstet Gynaec Brit Emp.*, 58, 558

VASCULAR SURGERY

See also B S.P., Vol. 8, p. 489, S. Key 343.

Vascular grafts

Viability of canine aortic transplant.—T
studied by McCune and Blades (1951).
used as a transplant is the entire aorta
limited, however, by the necessity for preserving the renal and mesenteric branches in the host or providing circulation through the transplanted vessel Suturing of these small vessels would be difficult and the results questionable. In the present study, dogs' entire aortas from the arch to bifurcation into iliac vessels, measuring up to 22 centimetres, were preserved in Tyrode's solution. These were later reimplanted by 2 methods: (1) into 18

the anastomosis with the graft. The operations were performed under intravenous Nembutal anaesthesia, and intratracheal oxygen or air was administered by an automatic flutter valve machine. Intravenous saline or blood was given throughout Anticoagulants were used

closed by thrombosis. Thrombosis did not occur in the 4 end-to-end anastomoses. There were no deaths from breakdown of graft walls, the length of grafts did not affect their viability. The study showed the importance of the following factors in preventing thrombosis. careful suture by end-to-end anastomosis, avoiding angulation, stenosis and injury by tight clamps; double ligation of branches close to the vessel to prevent dimpling of the intima; use of grafts kept for not more than 15 days, and provision of adequate blood supply to transplanted vessels

Blood-vessel bank.—Important factors in the establishment of a blood-vessel bank for the supply of homologous vascular grafts are presented by Keefer and his co-workers

is used.
The quick-freezing method may enable grafts to be stored for longer periods than those

obtainable by the nutrient-medium method; the frozen grafts, however, are probably not viable, so far as tissue growth is concerned. The results of investigations on dogs suggest that vascular material stored by the nutrient-medium method for more than approximately 8 weeks is usually unsatisfactory for grafts, because thrombosis, possibly due to degeneration of the intima, occurs.

Coarctation of the aorta

Treatment by grafting.—The treatment of certain aortic coarctations by homologous grafts is discussed by GROSS (1951). A satisfactory aortic pathway of permanent value is most likely to be achieved by excision of the coarctation with an everting type of end-to-end anastomosis. The use of interrupted mattress stitches of No. 00000 Deknated silk around the entire suture line gives the area the best chance of expanding and growing, a factor of considerable importance in an individual who has not attained full growth. In a few cases, however, such reconstruction is not practicable. Indications for grafting fall into 4 categories: (1) cases with a very long segment of narrowing; (2) a relatively short constriction, above and below which the aorta is rigid and inelastic, a condition most likely to be encountered in adults; (3) the presence of an aneurysm of the aorta or intercostal arteries; and (4) surgical injury to a portion of the aorta or its major branches. A series of 19 cases treated by grafting is recorded. In the first 16 cases, the graft had been obtained, under sterile conditions, from necropsy or medical-examiner material, and preserved in a modified Tyrode's solution, containing 10 per cent human serum and 1 per cent glucose, and buffered to maintain a pH near normal physiological level. The vessels were stored at a temperature of [illegible] and stored in a carbon dioxide refrigerator at −15° C. The grafts had been kept for 21, [illegible] and 72 days respectively, before use. The grafts in 2 cases had been collected without aseptic technique and had bacterial contamination. These were given high-voltage cathode-ray irradiation, to the extent of 2,000,000 "roentgen equivalent physical units"; no infection developed in the recipient patients. Two deaths occurred in the series, both from causes unrelated to the grafting. Examination of the survivors after periods ranging from a few months to 3 years have shown excellent results in 14 cases.

Results of operation.—A study of 70 cases of coarctation of the aorta, in which surgical exploration was performed, is presented by CLAGETT and JAMPOLIS (1951). Exploration revealed inoperable lesions in 8 cases. The ages of the patients who underwent operation [illegible] tion, 19 patients were asymptomatic and 23 were almost asymptomatic. The diagnosis in [illegible] nometer and the examining [illegible] present in 37 patients; in only [illegible] were usually conspicuously dilated. Pulsation in the abdominal aorta was absent in almost all cases, and that in the arteries of the leg was markedly diminished. Radiographic examination is stated to be frequently diagnostic: in the present series only 1 thoracic skiagram was negative. Angio[illegible] included 13 [illegible] t-operative day. [illegible] eration early in [illegible] with end-to-end anastomosis, as the treatment of choice.

Pulmonary stenosis

Kymography and catheterization.—KJELLBERG and RUDHE (1951) believe that electrokymographic investigation yields significant results in cases of pulmonary stenosis. Abnormal patterns were detected in 8 cases, and the diagnosis was verified by means of cardiac cathe-

terization. Electrokymograms of the pulmonary artery were recorded for 3 patients suffering from pulmonary stenosis, and the following abnormalities were detected: (1) sine-curve appearance with a slowly rising upward deflection, (2) either partial reduction or complete absence of the incisura and the secondary waves of the descending slope. The changes were analogous to those obtained from the descending aorta in coarctation A female patient, aged 16 years, was found to have a coarse systolic murmur in the praecordial region, with maximal intensity in the pulmonary area. No dyspnoea occurred while the patient was at rest, but moderate cyanosis was present and its intensity was increased by exercise X-ray examination of the chest revealed enlargement of the right ventricle, moderate enlargement of the pulmonary artery, a slight concavity in the region of the pulmonary conus, and a decrease in the vascular markings in the periphery of the lung fields. Electrokymography showed an abnormal pulmonary-artery tracing, and the diagnosis was confirmed by cardiac catheterization.

Mitral stenosis

Commissurotomy in treatment.—DAVID and GAGNON (1951) give an account of the treatment of mitral stenosis by commissurotomy based on a series of 11 cases In the assessment of results emphasis should be placed on the alteration in subjective symptoms As objective results are sometimes more acceptable the authors have recorded the pre-operative and post-operative left intra-auricular pressures in the last 6 cases of this series and found a

oedema, haemoptysis, peripheral emboli or right heart failure. In this series 7 cases developed auricular fibrillation during and after operation One reverted to sinus rhythm spontaneously. In the remainder, normal rhythm was restored in 3 by the use of quinidine sulphate, while of the 3 failures one died and the cause of death was found to be a section of the anterior leaflet

per cent of cases, with some improvement in 18·1 per cent

Finger-fracture valvuloplasty—The technique of finger-fracture valvuloplasty in the surgery of mitral stenosis is discussed by HARKEN and his co-workers (1951) Post-operative catheterization has demonstrated that this measure can correct mitral stenosis without producing mitral regurgitation. It is emphasized, however, that although the surgical technique is a simple one, the selection of patients and their anaesthetic management present considerable difficulty. As tachycardia increases the pulmonary blood pressure, and consequently the likelihood of pulmonary oedema, such factors as atropine, vagal block and

throughout the operation After Pentothal and ether induction, the patient is intubated, and continued on ether and oxygen, the "respiratory assister" being introduced into the closed anaesthetic system On the pericardium being exposed, a small incision is made just anterior

at this point of dislodging an unsuspected thrombus, the anaesthetist is asked to deliver

Results of ... the treatment of mitral

been used in a series of 19 selected cases; there was 1 patient in the age-group 20-29 years, 12 patients were
Only 10 patients
of mitral heart

have experienced recurrence of symptoms. The unsatisfactory results are attributed to poor selection of cases or to technical errors during operations. A review of 7 pre-operative case-histories suggests that the failures in 4 of these cases were due entirely to case selection; 1 patient had marked regurgitation, 1 had terminal heart failure, in 1 case the patient was

commissurotomy.

Chicago, 63, 337.
65, 409.
and Dickson, J. F. (1951).

Keefer, E. B. C., Andrus, W. DeW., Glenn, F., Humphreys, G. H., Lord, J. W., Jun., Murphy, W. B., and Touroff, A. S. W. (1951). *J. Amer. med. Ass.*, 145, 888.
Kjellberg, S R., and Rudhe, V. (1951). *Acta radiol*, *Stockh.*, 36, 133.
Lam, C. R. (1951). *Arch. Surg.*, *Chicago*, 63, 349.
McCune, W. S., and Blades, B. (1951). *Ann. Surg.*, 134, 769.

YAWS

See also B.S.P., Vol. 8, p. 588, S. Key 350.

Treatment

Antibiotic therapy.—The therapeutic valu
yaws is confirmed. AMPOFO and FINDLAY
Loughlin and Joseph, to clear lesions in

given terramycin, 1·5 grammes, daily for
were sterile in 48 and 72 hours, respective
rapid healing of early yaws and tropical ulcer, was observed.

Ampofo, O., and Findlay, G. M. (1951) *Trans. R. Soc. trop. Med. Hyg.*, 45, 261.

NOTER-UP, 1952

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